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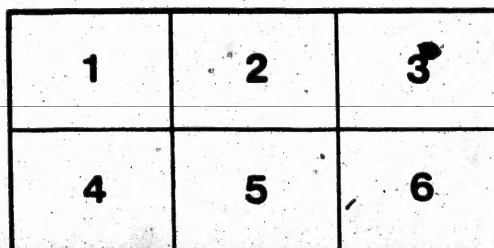
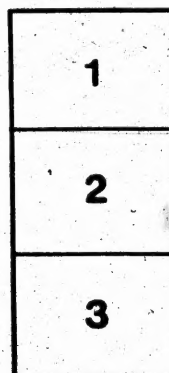
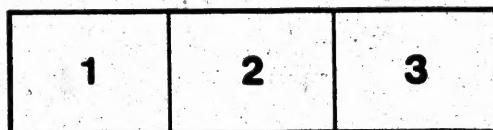
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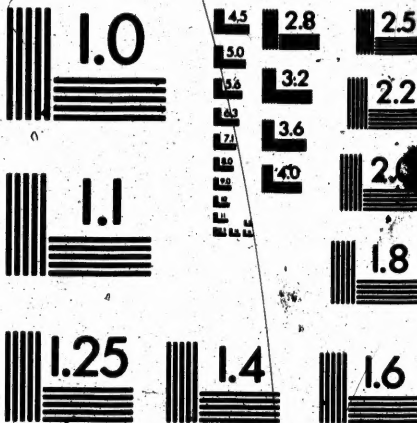
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PREFACE

The authors of this series of Arithmetic "School, Home, and College" is the school public for the purpose of this series is to provide for popular favor. The series is prepared by teachers actively engaged in the work of the schoolroom, and as teachers they are fully aware of the great difficulty that the average teacher encounters in the presentation of new and crisp problems for the study of the classroom.

The authors would most respectfully request consideration of the following points in connection with this series:

1. Mechanical Work. After pupils have passed the first stage of the series, the text books provide but very little work in the mechanical operations. Pupils become careless and less accurate as they advance, and they lose the speed and accuracy which they acquired in the lower forms. To meet this difficulty, this series provides over 5,000 operations in the mechanical work, which the teacher will find tested for accuracy. The labor (and loss of time) of performing this work is saved. This feature alone should command the position of every teacher of the subject.

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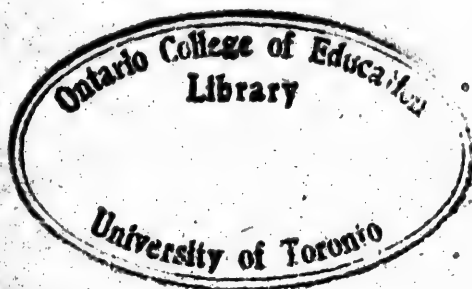
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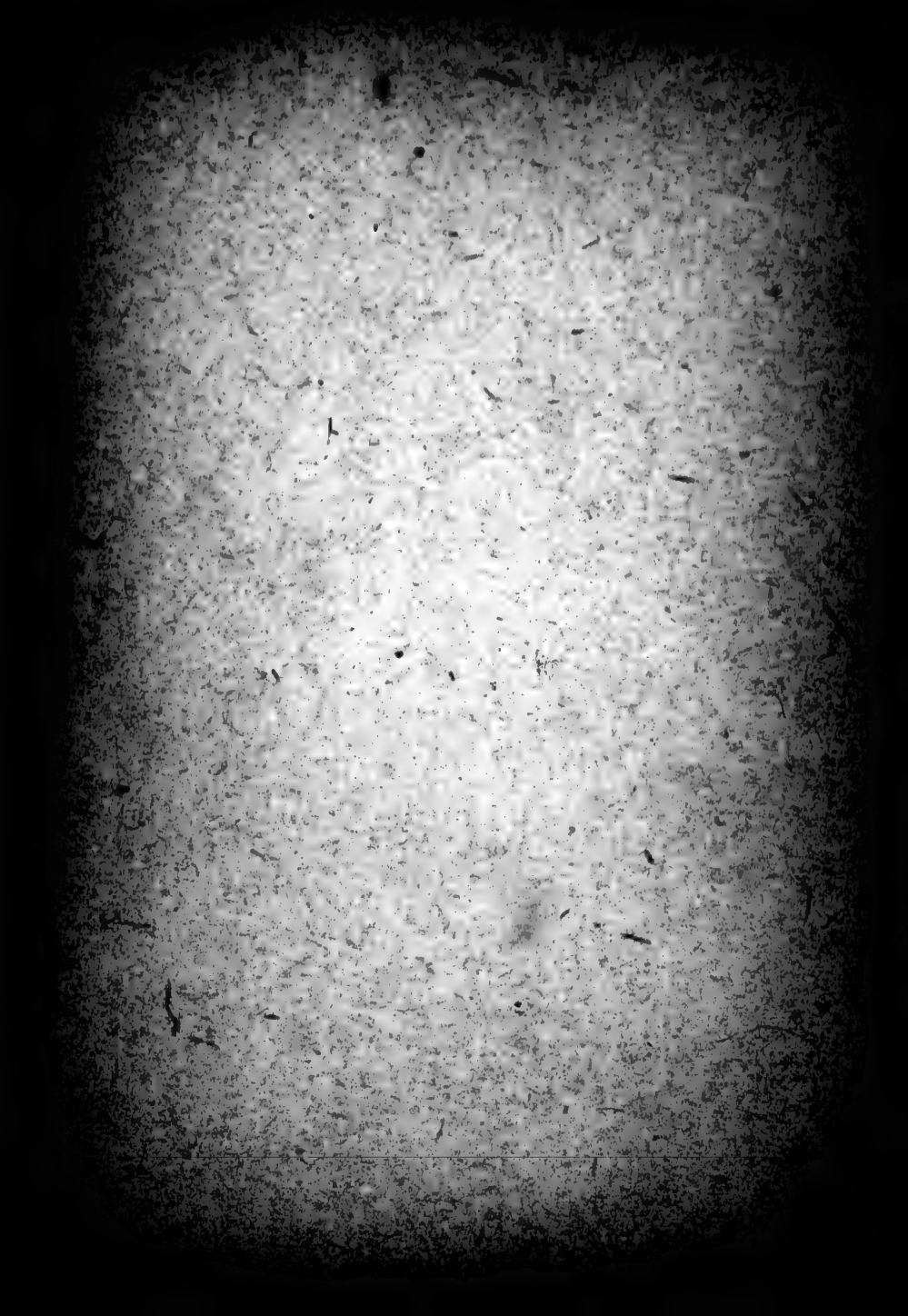
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No Answers. In the Pupils' Edition no answers are provided; the Teachers' Edition alone contains the answers.

Saving in Time. The time of the teacher is too precious to be taken up in the dictation of problems to a class, and by a more little each pupil may be provided with a problem for himself.

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19411161600348460652160250709054134085018743984229212186394599379435520, 38822323200696921304320501418108268170037487968458424372789198758871040, 77644646401393842608641002836216536340074975936916848745578397517742080, 155289292802787685217282005672433072680149951873833697491156795035484160, 310578585605575370434564011344866145360299903747667394982313590070968320, 621157171211150740869128022689732290720599807495334789964627180141936640, 1242314342422301481738256045379464581441199614990669579929254360283873280, 2484628684844602963476512090758929162882399229981339159858508720567746560, 4969257369689205926953024181517858325764798459962678319717017441135493120, 9938514739378411853906048363035716651529596919925356639434034882270986240, 19877029478756823707812096726071433303059193839850713278868069764541972480, 39754058957513647415624193452142866606118387679701426557736139529083944960, 79508117915027294831248386904285733212236775359402853115472279058167889920, 159016235830054589662496773808571466424473550718805706230944558116335779840, 318032471660109179324993547617142932848947101437611412461889116232671559680, 636064943320218358649987095234285865697894202875222824923778232465343119360, 1272129886640436717299974190468571731395788405750445649847556464930686238720, 2544259773280873434599948380937143462791576811500891299695112929861372477440, 5088519546561746869199896761874286925583153623001782599390225859722744954880, 10177039093123493738399793523748573851166307246003565198780451719445489909760, 20354078186246987476799587047497147702332614492007130397560903438890979819520, 40708156372493974953599174094994295404665228984014260795121806877781959639040, 81416312744987949107198348189988590809330457968028521590243613755563919278080, 162832625489975898214396696379977181618660915936057043180487227511127838556160, 325665250979951796428793392759954363237321831872114086360974455022255677112320, 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2667849736027765116344675473489546143640140446696358595469102735542318506904125440, 5335699472055530232689350946979092287280280893392717190938205471084637013808250880, 10671398944111060465378701893958184574560561786785434381876410942169274027616501760, 21342797888222120930757403787916369149121123573570868763752821884338548055233003520, 42685595776444241861514807575832738298242247147141737527505643768677096110466007040, 85371191552888483723029615151665476596484494294283475055011287537354192220932014080, 170742383105776967446059230303330953192968988588566950110022575074708384441864028160, 341484766211553934892118460606661906385937977177133900220045150149416768883

6. 12345 and 54321, having 1 period.
7. 12345 and 54321, having 2 periods.
8. 123456789 and 987654321, having 3 periods.
9. 12345 and 54321, having 2 periods.
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98. 12345 and 54321, having 2 periods.
99. 12345 and 54321, having 2 periods.
100. 12345 and 54321, having 2 periods.

II.—FRACTIONS.

Reduce to a simple fraction :

1. $\frac{\frac{1}{2} + \frac{1}{3} + \frac{1}{4}}{\frac{1}{2} + \frac{1}{3} + \frac{1}{4}} \times 7\frac{1}{2}$ of $\frac{1}{2}$.
2. $\left(\frac{\frac{1}{2} - \frac{1}{3}}{\frac{1}{2} + \frac{1}{3}} + \frac{\frac{1}{3} - \frac{1}{4}}{\frac{1}{3} + \frac{1}{4}} \right) + \left(\frac{\frac{1}{3} - \frac{1}{4}}{\frac{1}{3} + \frac{1}{4}} - \frac{\frac{1}{4} - \frac{1}{5}}{\frac{1}{4} + \frac{1}{5}} \right)$.
3. $\frac{10\frac{1}{2} - 7\frac{1}{2}}{12\frac{1}{2} - 9\frac{1}{2}} - \left(\frac{8\frac{1}{2}}{10\frac{1}{2}} \times \frac{12\frac{1}{2}}{10\frac{1}{2}} + 3\frac{1}{2} \right) + 10\frac{1}{2}$.

$$(3 \times 5 + 11) \times (4 - 2)$$

$$= 24$$

$$= 24$$

$$= (2 - 1.25) \times$$

$$= (2 - 1.25) \times$$

$$= 2.5 \times 0.75 = 1.875$$

$$= 1.875$$

$$\left(\frac{2 \times 1.25}{1 + 1.25 \times 2} \right) + \left(\frac{1 - 1.25 + \frac{0.25}{7.5}}{7.5 \times \frac{1 + 1.25 \times 2}{1 + 1.25 \times 2} - 7.5} \right)$$

$$\left(\frac{2 \times 1.25}{1 + 1.25 \times 2} \times \frac{1}{0.25} \right) + \left(\frac{1.25}{0.25} \times \left(\frac{1.25 - 2.5}{1.25 + 2.5} \times 10.5 \right) \right)$$

$$= 1.875$$

$$\left(\frac{1.25 - 2.5}{1.25 + 2.5} \times 10.5 \right) = \frac{1 - 0.25 - 0.25}{2.5 + 0.25}$$

FRACTION PROBLEMS

Example 1: A fraction is such that if the numerator is increased by 2, the fraction becomes $\frac{1}{2}$. If the denominator is increased by 3, the fraction becomes $\frac{1}{3}$. Find the fraction.

2. A merchant bought a number of bbls. of flour for \$1,600; he used 20 bbls., and sold $\frac{1}{4}$ of the remainder for \$1,500, which was 20% more than he paid for many bbls. did he buy?

3. A, B and C, having equal shares of a ship, sold respectively $\frac{1}{4}$, $\frac{1}{5}$ and $\frac{1}{6}$ of their shares to D, E and F, and leaves his share equally among them. What part of C's interest in the ship he now holds? What is the value of A's share?

4. The numerator of a certain fraction is $\frac{1}{2}$ as much as its denominator and the sum of the numerator and denominator is 352. Find the fraction.

5. Find what fraction must be subtracted from

$$\frac{1\frac{1}{2} \text{ of } 3\frac{1}{2}}{3\frac{1}{2} \text{ of } 2\frac{1}{2}} \text{ of } \frac{1\frac{1}{2} \text{ of } 1\frac{1}{2}}{32\frac{1}{2}} + \frac{2\frac{1}{2} \text{ of } 4\frac{1}{2}}{3\frac{1}{2} \text{ of } 4\frac{1}{2}} \text{ to make it}$$

$$1\frac{1}{2} \text{ of } \frac{\quad}{3\frac{1}{2}}$$

$$\text{equal to } \frac{1}{28\frac{1}{2}} \text{ of } 3\frac{1}{2} \text{ of } 3\frac{1}{2} \text{ of } 1\frac{1}{2} \times \frac{1}{2}.$$

6. Out of a certain sum I take \$2 more than the $\frac{1}{2}$; then \$10 less than $\frac{1}{3}$ of the remainder; then \$5 less than $\frac{1}{4}$ of what still remained; after which I have left \$10. Find the original sum.

7. A does $\frac{1}{3}$ of a piece of work in 3 hours; B does $\frac{1}{4}$ of what remains in 2 hrs.; and C finishes the remainder of the work in 80 mins. In what time would all working together do the work?

8. I bought $\frac{1}{2}$ of $4\frac{1}{2}$ cords of wood for $\frac{1}{3}$ of $\frac{1}{4}$ of \$100; what were 2 cords worth at the same rate?

9. What fraction divided by $(\frac{1}{2} + \frac{1}{3}) + (2 - \frac{1}{4})$ will give $\frac{1}{2}$ of $\frac{4\frac{1}{2}}{6\frac{1}{2}}$ of $\frac{347}{11\frac{1}{2}}$?

10. A can do a work in one-half the time B requires; B can do it in two-thirds of the time C takes. All

IV. Writing. The possession of these problems by the scholar will tend to preserve his handwriting from the mad rush in copying questions from classmate.

V. Understanding of Terms. Without precise and clear definitions of terms, problems are specially calculated to fix in the pupil's mind a thorough understanding of the technical terms of arithmetic.

VI. New Problems. The great majority of the problems of the series have been written specially for these "School Helps." They are not simply a re-statement of old, stereotyped problems.

VII. Problems Grouped. The problems are not arranged in the ordinary "hit and miss" fashion, but are grouped according to types, and carefully graduated in degree of difficulty.

VIII. Time Tests. The purely mechanical operations of addition, subtraction, etc., are intended to be done at a pupil's best speed, a specified time being allowed as the teacher's experience finds suited to the ability of the class.

IX. Book of Exercises. This series is not in any sense designed to displace either the teacher or the accustomed text. There is no attempt to show how to teach; this is taken for granted. It merely furnishes ready to the teacher's hand bright, crisp, new problems with which to enforce his teaching.

EXERCISES IN ARITHMETIC

FOR FIFTH CLASSES.

ADDITION TESTS.

(3)	(3)	(4)	(5)
88376	88376	32768	27683
83276	32768	27683	76832
32768	27683	76832	68327
27683	76832	68327	83276
76832	68327	83276	32768
68327	83276	32768	27683
83276	32768	27683	76832
32768	27683	76832	68327
27683	76832	68327	83276
76832	68327	83276	32768
68327	83276	32768	27683
83276	32768	27683	76832

(7)	(8)	(9)	(10)
84659	84659	84659	46598
84659	84659	46598	65984
84659	46598	65984	59846
46598	65984	59846	84659
65984	59846	84659	46598
59846	84659	46598	65984
84659	46598	65984	59846
46598	65984	59846	84659
65984	59846	84659	46598
59846	84659	46598	65984
84659	46598	65984	59846

12. 4.45346 and $.35346$ to four places.
13. 8.17 and 2.06 to four places.
14. $.318$ and $.7438$ to four places.
15. 3.146 and 4.207 to four places.
16. 17.373 and 365.64567 to four places.
17. Find to the nearest cent the value of 9100 .
18. Find to the nearest cent the value of 71100 .
19. Find to the nearest cent the value of 3100 .
20. Find to the nearest cent the value of 8100 .

VII.—DIVISION OF DECIMALS.

Divide to 3 places of decimals :

1. 1.5708 by 28.645 .
2. 28.64785 by $.806$.
3. 1.22475 by $.7071$.
4. Divide 3549305 by 1.1512928 to 5 places.
5. Divide $.5$ by 1.15929 to 5 places.
6. Divide 339 by 1005 to 4 places.
7. Divide $.150518$ by $.317167$ to 4 places.

Find by the contracted method the quotients of

8. 0.931472 by $.2302556$ to 3 places.
9. 89.985 by $.2302556$ to 3 places.
10. $250 \div 3.14159$ to 4 places.
11. $10 \div .43429$ to 5 places.
12. $.1 \div 3.14159$ to 5 places.
13. $2 \div 4.00517015$ to 3 places.
14. $93.725 \div 22.4173$ to 3 places.
15. $.45 \div .112891$ to 4 places.
16. $(1.23456) \div .23456$ to the fourth decimal place.
17. Find the quotient of 1 by (2.44444) to the fourth decimal place.

(11)	(12)	(13)	(14)
07314	73140	31407	14073
58069	80693	90693	69308
73140	31407	14073	40731
80693	90693	62082	20827
31407	14073	40731	07314
90693	03589	25896	58963
14073	40731	07314	73140
03589	25896	58963	00000
40731	07314	73140	31407
25896	58963	80693	90693
07314	73140	31407	14073
58963	80693	90693	69308

(16)	(17)	(18)	(19)
47963	25894	59179	07313
79634	58949	91726	73082
23456	34567	45678	56789
78912	89123	91234	12345
34567	45678	56789	07312
89123	91234	12345	23456
45678	56789	67890	78901
91234	12345	23456	34567
56789	67890	78901	89012
12345	23456	34567	45678
67890	78901	89012	90123
23456	34567	45678	56789

Add 00000 ten times consecutively to the first column, beginning with the following lines, and add the ten consecutive sums : (21) 00147 ; (22) 73082 ; (23) 80693 ; (24) 31489 ; (25) 27684.

Add 77777 ten times, etc. :

(26) 87294 ; (27) 68902 ; (28) 79218 ; (29) 07123 ; (30) 84127.

Add 88888 ten times, etc. :

(31) 57682 ; (32) 90063 ; (33) 21247 ; (34) 43973 ; (35) 37943.

Multiply each by 9 twelve times in sequence (1)
12104; (32) 14749; (33) 19056; (34) 22112; (35) 25168;
(36) 29484; (37) 33312; (38) 44226; (39) 55138; (40)
66050

Multiply each of the following by 468: (51) 10664; (52) 11664; (53) 13824; (54) 15568; (55) 20736; (56) 22736; (57) 27648; (58) 31104; (59) 41472; (60) 46080.

DIVISION TESTS

Divide each by 7 twelve consecutive times; (6) 209712
233050454 ; (7) 598628844067272 ; (8) 59943540100000
(9) 899157699151632 ; (10) 1348736548727448.

Divide each by 9 twelve consecutive times: (1) 10248803019822528; (2) 10248803019822528; (3) 10248803019822528; (4) 10248803019822528; (5) 10248803019822528; (6) 10248803019822528; (7) 10248803019822528; (8) 10248803019822528; (9) 10248803019822528; (10) 10248803019822528; (11) 10248803019822528; (12) 10248803019822528.

Divide each of the following by 1296: (31) 16000000
(32) 87340362; (33) 174284976; (34) 119621000; (35)
90018048.

Find each of the following by 5162 r (41) 1234567890; (42) 9876543210; (43) 2345678901; (44) 3456789012; (45) 4567890123; (46) 5678901234; (47) 6789012345; (48) 7890123456; (49) 8901234567; (50) 9012345678.

I. MEASURES AND MULTIPLES.

A.

1. Find L.C.M. of 545, 23487, 1853 and 11421.
2. Resolve 132333 and 107333 into their prime factors, and find their L.C.M.
3. Resolve 16335 and 18015 into their prime factors, and from inspection of these find their G.C.M.
4. Find the prime factors of 13230, 23050, and 20635. By means of these find their G.C.M. and L.C.M.
5. Resolve 34550 and 45890 into their prime factors, and from inspection find the quotient when their G.C.M. is divided into their L.C.M.
6. Find the L.C.M. of $2\frac{1}{2}$, $3\frac{1}{2}$, $3\frac{1}{3}$, and $14\frac{1}{2}$.
7. Find the L.C.M. of $\frac{10}{15}$, $1\frac{1}{2}$, and $3\frac{1}{2}$.
8. Find the G.C.M. of $\frac{1}{10}$, $1\frac{1}{2}$, $2\frac{1}{2}$, and $2\frac{1}{2}$.
9. Divide the L.C.M. of $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, and $\frac{1}{5}$ by the G.C.M. of $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, and $\frac{1}{5}$.
10. What is the greatest number that will divide 107375 and 68131, leaving remainders 49 and 26 respectively?
11. A number is composed of the following factors: 2^3 , 2^2 , 3^2 , 11 and 17; find the number.
12. Find the sum of all the divisors of 810.

B.

1. Find the product of the following:
234567 and 334567, having 3 partial products.

IX.—MISCELLANEOUS EXERCISES DECIMALS.

Find the value correct to 5 dec. places of :

$$1. \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5} + \frac{1}{6} + \dots$$

$$2. \frac{1}{3} + \frac{1}{4} + \frac{1}{5} + \frac{1}{6} + \frac{1}{7} + \frac{1}{8} + \dots$$

$$3. \frac{1}{4} + \frac{1}{5} + \frac{1}{6} + \frac{1}{7} + \frac{1}{8} + \frac{1}{9} + \dots$$

$$4. \frac{1}{1} + \frac{1}{5} + \frac{1}{5^2} + \frac{1}{5^3} + \frac{1}{5^4} + \frac{1}{5^5} + \dots$$

$$5. \frac{1}{1} + \frac{1}{6} + \frac{1}{6^2} + \frac{1}{6^3} + \frac{1}{6^4} + \dots$$

Find the value correct to 4 places :

$$6. 1 + \frac{1}{1 \times 2} + \frac{1}{1 \times 2 \times 3} + \frac{1}{1 \times 2 \times 3 \times 4} + \dots$$

$$7. 1 + \frac{1}{1 \times 3} + \frac{1}{1 \times 3 \times 5} + \frac{1}{1 \times 3 \times 5 \times 7} + \dots$$

$$8. \frac{1}{5} + \frac{1}{3 \times 5^2} + \frac{1}{5 \times 5^3} + \frac{1}{7 \times 5^4} + \dots$$

9. Reduce to a decimal

$$2 + \frac{1}{2 \times 3} + \frac{1}{2 \times 3 \times 4} + \frac{1}{2 \times 3 \times 4 \times 5} + \frac{1}{2 \times 3 \times 4 \times 5 \times 6} + \dots$$

10. Reduce to a decimal

$$2 + \frac{1}{2 \times 4} + \frac{1}{2 \times 4 \times 6} + \frac{1}{2 \times 4 \times 6 \times 8} + \frac{1}{2 \times 4 \times 6 \times 8 \times 10} + \dots$$

3. 24199 and 75004, having 2 partial products.
4. 40067 and 15613, having 3 partial products.
5. 149336 and 61834, having 3 partial products.
6. 125732408 and 824672003, having 4 partial products.
7. 45678 and 12537, having 2 partial products.
8. 987654 and 39768, having 5 partial products.
9. The L.C.M. of two numbers, one of which is 924; their G.O.M. is 12; find the other.
10. The L.C.M. of two numbers is 234000; their G.O.M. is 6187; one of the numbers is 4056; find the other.
11. The driving wheels of a locomotive are 18 in. in circumference, and the trucks 19 in.; what distance will the train move to bring wheel and truck into the same relative position as at starting?
12. A hall 60 ft. long is to be carpeted. It is done by stretching the carpet lengthwise, any number of pieces—widths, respectively, $\frac{1}{2}$ yd., $\frac{1}{3}$ yd., $\frac{1}{4}$ yd., and $1\frac{1}{2}$ yds., will exactly fit the hall. If the narrowest piece, worth \$1.10 a yard, be chosen, what will it cost to carpet the hall?

II.—FRACTIONS.

Reduce to a simple fraction :

1.
$$\frac{\frac{1}{2} + \frac{1}{3} + \frac{1}{4}}{\frac{1}{2} + \frac{1}{3} + \frac{1}{4}} \times 7\frac{1}{2} \text{ of } \frac{1}{11}.$$
2.
$$\left(\frac{\frac{1}{2} - \frac{1}{3}}{\frac{1}{2} + \frac{1}{3}} + \frac{\frac{1}{3} - \frac{1}{4}}{\frac{1}{3} + \frac{1}{4}} \right) + \left(\frac{\frac{1}{4} - \frac{1}{5}}{\frac{1}{4} + \frac{1}{5}} - \frac{\frac{1}{5} - \frac{1}{6}}{\frac{1}{5} + \frac{1}{6}} \right).$$
3.
$$\frac{10\frac{1}{2} - 7\frac{3}{8}}{12\frac{1}{3} - 9\frac{7}{8}} - \left(\frac{8\frac{1}{2}}{10\frac{1}{2}} \times \frac{12\frac{1}{2}}{16\frac{1}{2}} + 3\frac{1}{2} \right) + 10\frac{1}{4}.$$

$$= 1\frac{1}{2} \times 2\frac{1}{2} + (4 \times 1) + 1\frac{1}{2} \times 1 \times (3\frac{1}{2} - 2)$$

$$= 1\frac{1}{2} \times 2\frac{1}{2} + 4 + 1\frac{1}{2}$$

$$= 1\frac{1}{2} \times 2\frac{1}{2} + 5\frac{1}{2}$$

$$= 3\frac{1}{2} \times (4 - (3\frac{1}{2} - 1\frac{1}{2})) +$$

$$= 3\frac{1}{2} \times (4 - 2) = 3\frac{1}{2} \times 2 = 7$$

$$= 3\frac{1}{2} \times 2 = 7$$

$$= 3\frac{1}{2} \times 2 = 7$$

$$\left(\frac{1\frac{1}{2} \times 2\frac{1}{2} + 1\frac{1}{2}}{1 + 4\frac{1}{2} \times 2} \right) + \left(\frac{1\frac{1}{2} \times 2\frac{1}{2} + 1\frac{1}{2}}{1 + 4\frac{1}{2} \times 2} \right) \times 4\frac{1}{2}$$

$$\left(\frac{1\frac{1}{2} \times 2\frac{1}{2} + 1\frac{1}{2}}{1 + 4\frac{1}{2} \times 2} \right) \times \frac{1}{2\frac{1}{2}} + \left(\frac{1\frac{1}{2}}{6\frac{1}{2}} + \left(\frac{1\frac{1}{2} - 2\frac{1}{2}}{11\frac{1}{2} + 2\frac{1}{2}} \right) \times 10\frac{1}{2} \right)$$

$$\frac{1\frac{1}{2}}{2\frac{1}{2}}$$

$$\left(\frac{1\frac{1}{2} \times 11\frac{1}{2} + 1\frac{1}{2} \times 7\frac{1}{2}}{2\frac{1}{2} \times 2\frac{1}{2}} + 0\frac{1}{2} \right) + \frac{1\frac{1}{2} \times 6\frac{1}{2} - 2\frac{1}{2}}{2\frac{1}{2} \times 1\frac{1}{2} \times 2\frac{1}{2}}$$

III. FRACTION PROBLEMS.

Example 1. A man has 100 rupees. He has 10% of his money in bank, 20% of his money in hand, and the rest in a bank. He has 10% of his money in bank, 20% of his money in hand, and the rest in a bank. He has 10% of his money in bank, 20% of his money in hand, and the rest in a bank.

2. A number is increased 25% and the result is 150. What was the original number?
3. How many dollars make a dollar is the same as how many cents make a cent?
4. If 8 gal. of water are added to 48 gal. of wine, what per cent. of the mixture is water?
5. How much water will dilute 12 gal. of spirit 61% strong to 78%?
6. In an examination of 250 candidates, 12% of the whole obtain honors, and 60% of the remainder pass. How many fail to pass?
7. The demand of 10 hours pay for 9 hours work is equivalent to a demand of what increase per cent. in wages?
8. A grocer sells 14 lbs. of sugar for \$1, but the cost of sugar advances 10%; how many lbs. can he now sell for the dollar?
9. A man who owned $5\frac{1}{2}\%$ of a mine sold 45% of his share for \$27,000; what was the value of the mine?
10. A's money is 23% more than B's; how much per cent. is B's of A's?
11. One still is what per cent. of three-fourths?
12. A speculator sold a house for 84% profit and with the money purchased another, which he sold for \$4,020, losing 16%. What did the first house cost him?
13. A bankrupt was able to pay 40% of his debts, but not a debt of \$600 proved worthless; now he is able to pay only 25% on the \$1. Find the total amount of his liabilities.

C.

1. One number is double another; 12% of the greater and 16% of the smaller make 54. Find their sum.
2. A bankrupt pays 60% of his debts; the amount that a creditor receives is what per cent. of that which he lent?

2. A merchant bought a number of bbls. of flour for \$1,500; he used 20 bbls., and sold $\frac{2}{3}$ of the remainder for \$1,500, which was \$200 more than he had paid for many bbls. did he buy?
3. A, B and C, having equal shares of a ship, sold respectively $\frac{1}{4}$, $\frac{1}{3}$ and $\frac{1}{2}$ of their shares to D, who then and leaves his share equally among them. If B and C's interest in the ship be now worth \$20,000, what is the value of A's share?
4. The numerator of a certain fraction is $\frac{1}{2}$ as much again as its denominator and the sum of the numerator and denominator is 362. Find the fraction?
5. Find what fraction must be subtracted from

$$\frac{1\frac{1}{2} \text{ of } 3\frac{1}{2}}{3\frac{1}{2} \text{ of } 2\frac{1}{2}} \text{ of } \frac{1\frac{1}{2} \text{ of } 1\frac{1}{2}}{32\frac{1}{2}} + \frac{3\frac{1}{2} \text{ of } 6\frac{1}{2}}{3\frac{1}{2} \text{ of } 4\frac{1}{2}} \text{ to make it}$$

$$1\frac{1}{2} \text{ of } \frac{\quad}{3\frac{1}{2}}$$

$$\text{equal to } \frac{1}{28\frac{1}{2}} \text{ of } 3\frac{1}{2} \text{ of } 3\frac{1}{2} \text{ of } 1\frac{1}{2} \times \frac{1}{2}.$$

6. Out of a certain sum I take \$2 more than the $\frac{1}{2}$; then \$10 less than $\frac{1}{4}$ of the remainder; then \$5 less than $\frac{1}{3}$ of what still remained; after which I had left \$10. Find the original sum.
7. A does $\frac{1}{3}$ of a piece of work in 6 hours; B does $\frac{1}{4}$ of what remains in 2 hrs.; and C finishes the remainder of the work in 80 mins. In what time would all working together do the work?
8. I bought $\frac{1}{2}$ of $4\frac{1}{2}$ cords of wood for $\frac{1}{3}$ of $\frac{1}{2}$ of \$30; what were 2 cords worth at the same rate?
9. What fraction divided by $(\frac{1}{2} + \frac{1}{3}) + (3 - \frac{1}{2}) \times \frac{4\frac{1}{2}}{6\frac{1}{2}}$ will give $\frac{1}{2}$ of $\frac{\quad}{6\frac{1}{2}}$ of $\frac{\quad}{11\frac{1}{2}}$ of 247?
10. A can do a work in one-half the time B requires; B can do it in two-thirds of the time C takes. All

He had a sum of money. He spent $\$8$ more than $\frac{1}{2}$ of his money; $\$2$ less than $\frac{1}{3}$ of the remainder in buying shoes; and $\$1$ more than $\frac{1}{4}$ of what still remained in shoes; after which he had left $\$5$. How much had he at first?

10 4 horses are worth 7 cows, and 5 cows cost as much as 20 sheep, and 16 sheep cost $\$163$; find the value of 12 horses.

11 A person rides to town at the rate of $8\frac{1}{2}$ miles per mile per hour, and after resting 30 mins., walks back at the rate of $2\frac{1}{2}$ miles per hour. The whole time occupied was 7 hrs. 20 $\frac{1}{2}$ mins.; find the distance.

12 One-quarter of the time which a man spent on a journey from M to T he travelled by steamboat at an average rate of 14 mi. per hour; $\frac{1}{3}$ of the time he travelled by railway at an average rate of 26 mi. per hour; and the remaining hour of the time he spent the remaining 7 miles of his journey. Find the distance from M to T.

13 There is a mixture of vinegar and water in the proportion of 93 parts of vinegar to 7 parts of water; how much water must be added, so that in 26 parts of the mixture there may be 2 parts of water?

14 A, assisted part of the time by a boy, completed a job in 15 hours. The man received $\frac{1}{2}$ of the pay and the boy $\frac{1}{3}$; but the man was paid at double the rate the boy was in proportion to the amount of work each did. How long would the man unassisted have taken to accomplish the job?

15 A boy can run 6 times round a circular plot of ground in 20 seconds; another boy can run 5 times round the same plot in 20 seconds. If they start from the

6. A merchant marks his goods 20% above cost and allows 5% off for cash. What percent does he gain on an article of which the cost price is \$100?
7. What rate of discount is equivalent to giving 10% off on a counce of sugar with each pound for good measure?
8. What rate of discount is equivalent to giving 10% off on a yard with each yard for good measure?
9. A grocer mixes a pint of water with seven pints of vinegar. What trade discount will this enable him to give?
10. At what advance on cost must a merchant mark his goods, so that he may allow a discount of 25% and still gain 33 $\frac{1}{3}$ %?
11. What is the difference between 20% discount and 10%, 5 and 5% off?
12. A merchant gives a discount of 10%, but uses a standard measure $\frac{1}{2}$ inch too short; what discount would give him the same rate of gain if the measure was correct?

C.

1. What must I ask for velvet, which cost me \$10 a yard, so that I may fall 10%, and still make 10% after deducting 5% of the sales for bad debts?
2. A merchant reduced the marked price of an article by a certain per cent. He given the same per cent off this reduced price for cash. The cash price is now $\frac{3}{4}$ of the original marked price. Find the per cent.
3. From the list price of a line of goods a merchant is allowed a trade discount of 20%; a further discount of 10% off the trade price for taking a cash order and a still further discount of 5% off this for cash. Find his gain per cent. by selling at 10% less than the list price.
4. A bookseller charges on certain books 10% on the selling of the published price and gives a discount of 33%. What is the actual rate he charges on the selling?

same place as the next line, and so on, in the same direction, how many times the number of the line the factor has exceeded the dividend.

9. Find the least fraction which, added to $\frac{1}{11}$ and $\frac{1}{13}$ will make the sum an integer.
10. A person sold A $\frac{1}{2}$ of his land, B $\frac{1}{3}$ of the remainder, and C $\frac{1}{4}$ of what then remained, and retained $\frac{1}{8}$ from D for what he had left, of 975 acres, find the number of acres he had at first.
11. B runs a mile race with C and loses; had he been a third greater he would have won by 20 yards; what fraction is B's speed of C's?
12. A person buys four houses; for the second he pays half as much again as for the first; for the third he pays third as much again as for the first and second together; for the fourth, a fourth as much again as for the first, second and third together; he pays in all \$99,000; what is the cost of the fourth?

IV.—ADDITION OF DECIMALS

Find the sum of:

1. 27.4183, .079, 0.79, .079, 814.73 and 4.
2. 36.247183, .07, .0314, 1.3726, 11.7854, 26.2, 22.2.
3. 487.39, 61.499, 9.7164, .51257, .048766, .000001.
4. 4199, .384, .416, .1647, 31.3, 9.00417, 125.1279.
5. 702, .0001, .000001, 7.3, 73, and .0709.

Add, without reducing to vulgar fractions,—

6. $\frac{3}{15}$, $\frac{2}{4}$, and $\frac{2}{25}$.
7. 16.75, 14.315, 5.517, 3.3675.
8. 8.97, 12.934, 5.4173, 6.515.
9. 10.7, 2.3156, 2.235467, 91.54.

the following numbers, and the following

the following numbers, and the following

the following numbers, and the following

the following numbers, and the following
(1) 72112; (2) 72112; (3) 72112;
the following numbers, and the following
(1) 64441; (2) 64441; (3) 64441;
(4) 77054.

the following numbers, and the following
(1) 67883; (2) 72112; (3) 72112;
(4) 72112; (5) 72112.

the following numbers, and the following
(1) 72112; (2) 72112; (3) 72112; (4) 72112;
(5) 72112.

the following numbers, and the following
(1) 72112; (2) 72112; (3) 72112; (4) 72112;
(5) 72112.

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the following numbers, and the following
(1) 72112; (2) 72112; (3) 72112; (4) 72112;
(5) 72112.

MULTIPLICATION TESTS.

the following by 6, twelve times in
(1) 72112; (2) 72112; (3) 72112; (4) 72112;
(5) 72112; (6) 72112; (7) 72112; (8) 72112; (9) 72112;
(10) 72112.

the following by 7, twelve times in
(1) 72112; (2) 72112; (3) 72112; (4) 72112;
(5) 72112; (6) 72112; (7) 72112; (8) 72112; (9) 72112;
(10) 72112.

10. 6.21, 12.242, 22.222, 22.222.
11. 7.5, 12.22, 127.222, 22.222, 27.22.
12. 72.72, 11.22, 12.72, 12.22, 712.2222, 12.2222.

V.—SUBTRACTION OF DECIMALS.

1. Subtract 92.2764125 from 762.214788 six times consecutively and find the sum of the six remainders.
2. Subtract .74325409 six times consecutively from 2.02214227 and add the six remainders.
3. From 234.17666 take 527.322.
4. From 922.221 take 272.2222.
5. Find the difference between 1762.2222 and 227.2272.
6. Take 227.22222 from 1224.2272.
7. Take 12.222227 from 27.21222.
8. Subtract 22.222 from 122.221722.

VI.—MULTIPLICATION OF DECIMALS.

Find the product of :

1. 27.272 and 2.22.
2. 222.272 and .222.
3. 22222222 and 222.2.
4. 22222.2 and .222222.
5. 2222.222 and 2.2222.

Find by the contracted method the product of :

1. 222.22 and 22.27 to three places.
2. 222.272 and 2.2122 to three places.
3. 22222.2 and .2222 to three places.
4. 22.212222 and 22.222 to three places.
5. 27.2222 and 2.272 to four places.
6. 2.2222 and .2222 to four places.

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12. 2.49946 and $.99946$ to four places.
13. 5.17 and 2.06 to four places.
14. $.316$ and $.7439$ to four places.
15. 3.145 and 4.397 to four places.
16. 17.373 and 395.04597 to four places.
17. Find to the nearest cent the value of $\$100 \times (1.05)^4$.
18. Find to the nearest cent the value of $\$125 \times (1.05)^4$.
19. Find to the nearest cent the value of $\$100 \times (1.05)^5$.
20. Find to the nearest cent the value of $\$100 \times (1.05)^6$.

VII.—DIVISION OF DECIMALS.

Divide to 3 places of decimals:

1. 1.5708 by 28.645 .
2. 28.64785 by $.366$.
3. 1.23475 by $.7071$.
4. Divide $.549305$ by 1.1512925 to 5 places.
5. Divide $.5$ by 1.15029 to 5 places.
6. Divide 239 by 1065 to 4 places.
7. Divide $.150615$ by $.217137$ to 4 places.

Find by the contracted method the quotient of:

8. 6.931472 by $.2302525$ to 5 places.
9. 89.995 by 3.008968 to 5 places.
10. $250 + 3.141593$ to 4 places.
11. $10 + .43429448$ to 4 places.
12. $.1 + 3.14159265$ to 5 places.
13. $2 + 4.60517016$ to 3 places.
14. $93.725 + 22.4173$ to 3 places.
15. $.45 + .118891$ to 4 places.
16. $(1.23456)^2 + .23456$ to the fourth decimal place.
17. Find the quotient of 1 by $(3.14159)^2$ to the fourth decimal place.

VIII.

Reduce to simple vulgar fractions :

- (1) .9195, (2) .00075, (3) .72, (4) .135, (5) .7205, (6) .2045, (7) .055, (8) .26452, (9) 5.505, (10) .714285, (11) .0714285, (12) 14.9155.

B.

Reducing fractions to equivalent decimals.

1. Why do $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{16}$ reduce to finite decimals?
2. Why do $\frac{1}{3}$, $\frac{1}{6}$, $\frac{1}{12}$, $\frac{1}{24}$ reduce to pure circulating decimals?
3. Why do $\frac{1}{5}$, $\frac{1}{10}$, $\frac{1}{20}$, $\frac{1}{40}$ reduce to mixed circulating decimals?

How do you know the number of digits in the finite part of the decimal?

What is the limit to the number of digits in the repeating?

4. Reduce $\frac{1}{2}$ to a decimal; then without division write the decimals equivalent to $\frac{1}{4}$, $\frac{3}{4}$, $\frac{1}{8}$, $\frac{7}{8}$ respectively.

Reduce $\frac{1}{3}$ to a decimal, and then write the decimals equivalent to $\frac{2}{3}$, $\frac{1}{6}$, $\frac{5}{6}$, $\frac{1}{12}$, $\frac{11}{12}$ respectively. What cannot you write the decimal equivalent to $\frac{1}{5}$?

Reduce $\frac{1}{5}$ (by a very short process) to a decimal; then write down without dividing the equivalent decimal of $\frac{2}{5}$, $\frac{3}{5}$, $\frac{4}{5}$ respectively.

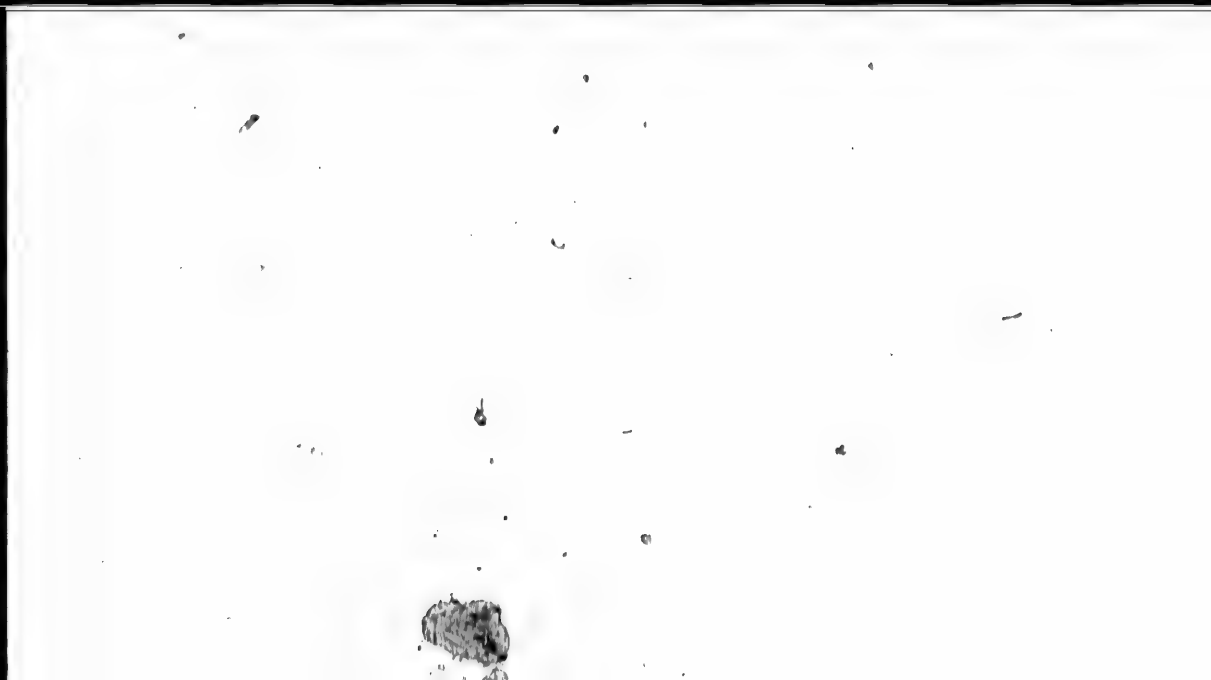
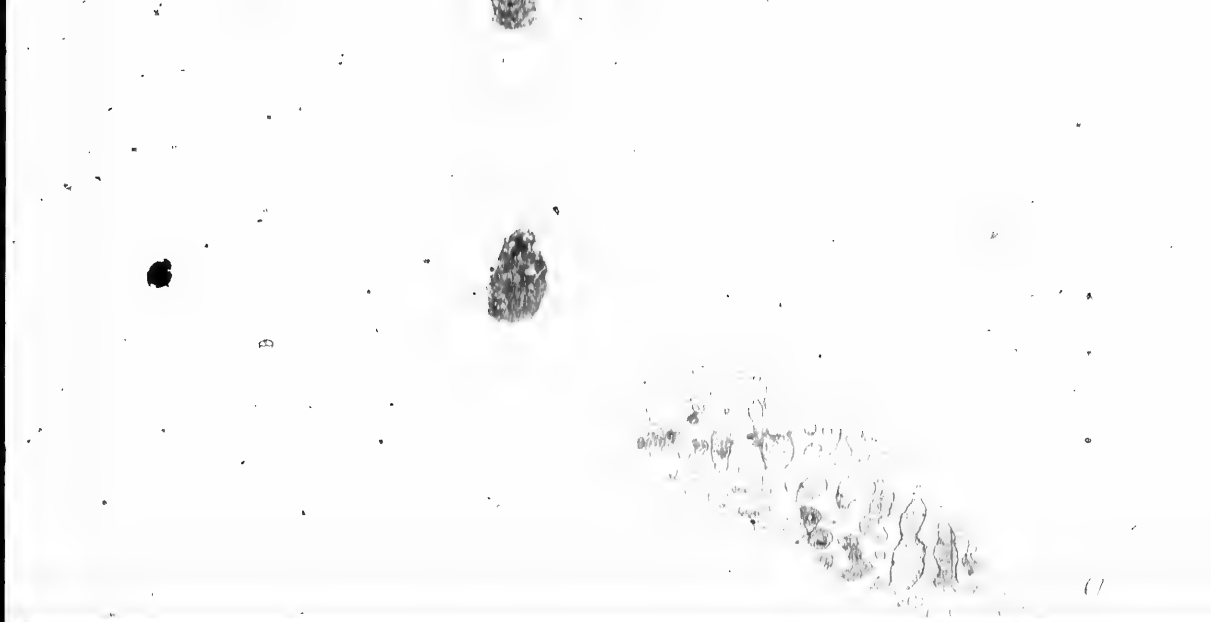
Reduce by short process, the following fractions: (6) $\frac{1}{25}$; (10) $\frac{1}{125}$; (11) $\frac{1}{625}$; (12) $\frac{1}{3125}$; (13) $\frac{1}{15625}$; (14) $\frac{1}{78125}$; (15) $\frac{1}{390625}$.

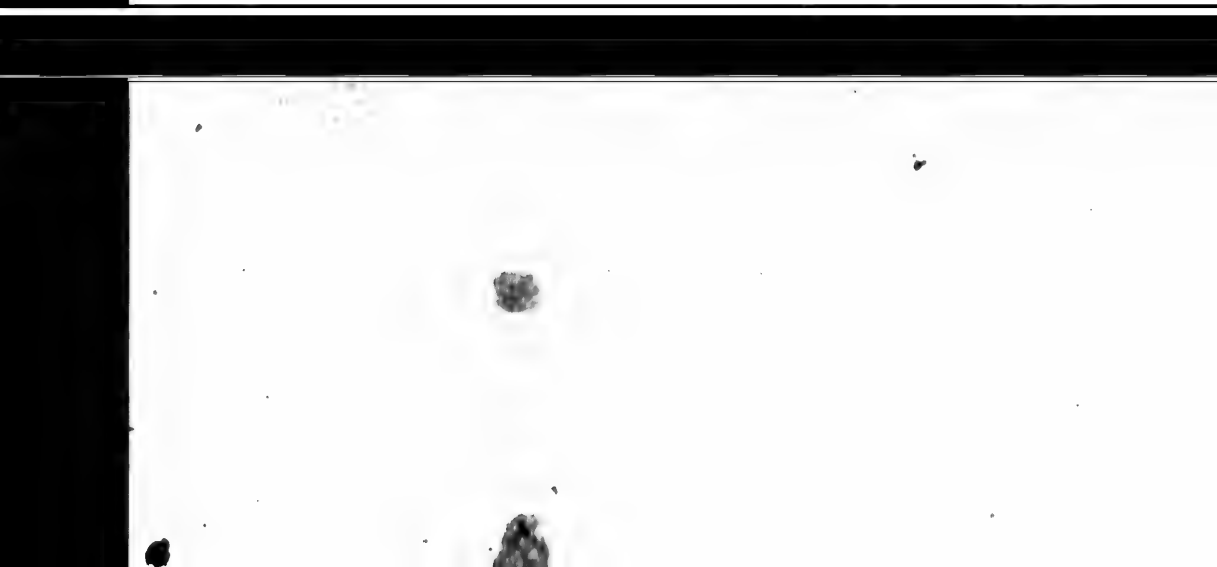
\$11.25 and contains 300 lbs., what per cent. of the weight is lost in retelling?

9. A farm cost $2\frac{1}{2}$ times as much as a house; by selling the house at 10% loss, and the farm at $7\frac{1}{2}$ % gain, \$3,992.20 is received. Find the cost of each.
10. I bought 84 yards of cloth at \$5.70 a yard. If it shrank 5% in length, find the selling price per yard to gain 30%.

C.

1. A bookseller deducts 10% from the marked price of his books, and after this has a gain of 25%. He sells a book for \$7.50; find the cost price of it, and what per cent. the marked price is in advance of the cost price.
2. A man sold 2 horses for \$120 each; on the one he gained 15%, and on the other he lost 15%. What per cent. did he gain or lose?
3. A merchant bought sugar at \$3.75 per cwt., and paid for freight and other charges $\frac{1}{4}$ of a cent per lb. How many lbs. can he sell for a dollar to make a clear gain of 25%?
4. A merchant bought 134 yds. of cloth at \$3.63 $\frac{1}{2}$ per yd., and 67 $\frac{1}{2}$ yds. at \$4.12 $\frac{1}{2}$ per yd. At what price per yd. must he sell the whole to realize a profit of 20%?
5. A merchant bought cloth at \$2 per yard, and sold the whole at a profit of \$120; had he sold it at 20% less he would have lost \$96. How many yards did he buy?
6. Instead of a yard measure a draper uses a stick which is 36.35 inches long. What does he lose per cent. by doing so?
7. How much per cent. does a grocer gain or lose by selling half a bbl. of sugar, giving only 15 oz. to the pound, and the other half giving 17 oz. to the pound?
8. A speculator sold a piece of land at a profit of 50%, but the buyer becomes bankrupt, and pays only 75c.





- on the dollar. What per cent. does this represent gain or loss?
14. A tailor buys cloth at \$1.75 a yard, which he shrinks 5%. At what price per yard must he sell it to gain 20% on his outlay?
15. A druggist gives a pound troy of certain goods for a pound avoird. Find his gain per cent. and the selling loss per cent.

XIV.—TAXES.

A.

Find the taxes on:

1. Assessed value \$3,700, rate $1\frac{1}{2}\%$.
2. Assessed value \$2,500, rate $1\frac{1}{2}\%$.
3. Assessed value \$8,500, rate $1\frac{1}{2}\%$.
4. On \$2,537 at 2c. on the \$.
5. On \$2,642 at $1\frac{1}{2}$ c. on the \$.
6. On \$3,900 at 15 mills on the \$.
7. On \$6,300 at 17 mills on the \$.
8. On \$8,240 at $17\frac{1}{2}$ mills on the \$.
9. When the rate of taxation is 15 mills on the dollar, what is the tax on property assessed at \$2,500?
10. The total assessed value of the property of a village is \$650,000. What tax will be raised at the rate of $12\frac{1}{2}$ mills on the dollar?
11. A tax of \$100,000 is to be levied on a county having taxable property to the value of \$4,700,000. What is the amount borne by A whose property is assessed at \$7,500?
12. A tax of \$6,900 is levied for building a schoolhouse. The assessed value of the town is \$2,300,000. What does a man pay whose property is assessed at \$1,200?
13. What sum must be assessed on a school district to build a schoolhouse worth \$2,175, and pay for the collection?

14. A's income is \$2000. What tax does he pay, \$100 being exempted, and the rate 15 mills on the dollar?
15. Find the net income of a man whose total income is \$435, on \$335 of which he pays a tax of 16 mills on the dollar.

B.

1. A tax of \$34,750 is to be levied on a town, the assessed valuation being 1.6 mills on the dollar; what tax does a man pay on an income of \$1,100, of which \$400 is exempted?
2. A farmer, whose property is assessed at \$9,000, pays on the dollar $1\frac{1}{2}$ mills for township rates, $1\frac{1}{2}$ for county rates, $1\frac{1}{2}$ for railway bonds and $2\frac{1}{2}$ for school rate. How much does he pay in all?
3. A man after paying an income tax of $15\frac{1}{2}$ mills on the dollar, and spending \$3.37 $\frac{1}{2}$ per day on an average, is able to save \$1,500.37 $\frac{1}{2}$ per year (365 days). Find his gross income?
4. The expense of constructing a bridge was \$5,500, which was raised by a tax on the assessable property of a town. The rate of taxation was \$5. on the \$, and the collector's commission was \$100. Find the assessed value of the town property.
5. The net amount received by a village for taxes is \$9,175. The rate of taxation is $1\frac{1}{2}$ mills on the \$, and the collector's charges 5% of the total taxes. What is the amount of the assessment?
6. A farmer pays \$24.75 taxes on property worth \$5,000 which is assessed for $\frac{1}{2}$ of its value. Find the rate.
7. At a small rate, a man who has \$400 of his salary exempted pays \$2.25. What was his salary?
8. A piece of real property is assessed for \$5,500, pays on the dollar 1.6 mills and other charges on general rates \$1.10 on the \$, the interest and other charges on the \$1.10 are 1.6 mills, the school tax is 1.6 mills, the tax for the library is 1.6 mills, the tax for the fire department is 1.6 mills, and the

General City purposes 1.387 mills. How much does he pay in all?

9. A township has assessable property amounting to \$475,000, and on a $3\frac{1}{2}$ mill rate they raise \$1,500, after paying the collector's charges. What per cent. of the taxes did the collector receive?
10. A man bought a farm for \$4,500; at the end of 3 mos. he paid his taxes levied on $\frac{1}{2}$ of the purchased value at 18 mills on the dollar; in another 8 mos. he spent \$425 on improvements, and at the end of the year he sold the farm for \$6,000. Find his gain, money being worth 5 per cent.

XV.—INSURANCE.

A.

Find the premium of insurance on:

1. Policy \$1,200, rate $\frac{1}{2}\%$.
2. Policy \$6,000, rate $\frac{3}{4}\%$.
3. Policy \$8,600, rate $2\frac{1}{2}\%$ for 3 years.
4. Policy \$1,800, for 5 years, rate $\frac{1}{2}\%$ for each year.
5. Policy \$560, at 90c. per \$100 for 3 years.
6. Policy \$6,000, for 4 years, at $1\frac{1}{2}\%$ per annum.
7. Policy \$5,000, at 1.17%.
8. What will it cost to insure a mill worth \$18,000 for $\frac{1}{2}$ of its value at $1\frac{1}{2}\%$?
9. What is the premium for insuring 4,840 bus. wheat, valued at \$1.20 a bus., at $1\frac{1}{2}\%$ on $\frac{1}{2}$ of its value?
10. A building was insured for \$2,500 in one company at $1\frac{1}{2}\%$, and for \$3,000 in another company at $1\frac{1}{2}\%$. What was the total premium?
11. Find the premium paid to insure a house worth \$7,500, for $\frac{1}{2}$ of its value, for 4 years, the rate being $\frac{1}{2}\%$ for each year.
12. A man insures a house worth \$4,000, for $\frac{1}{2}$ of its value, at 2% premium. If the house be destroyed,

find the total loss sustained by the owner after one premium has been paid.

B.

1. Find the premium paid to insure a horse worth \$7,500 for $\frac{3}{4}$ of its value, for 3 years, the rate being $\frac{1}{4}\%$ of the policy for each year.
2. A factory valued at \$17,600 is insured for $\frac{1}{2}$ of its value in two companies, the first taking $\frac{3}{4}$ of the risk at $\frac{1}{4}\%$, the second the remainder at $\frac{1}{4}\%$. Find the total amount of premium.
3. A vessel running between Oswego and Hamilton is insured for \$12,850 at the rate of $1\frac{1}{2}\%$ per month. To what does the premium of insurance amount from April 10th to November 10th?
4. An insurance company took a risk of \$9,600 at $2\frac{1}{4}\%$, and immediately re-insured $\frac{1}{2}$ of it in another company at 3% . If the property be destroyed find the loss sustained by each company.
5. A company took a risk at $3\frac{1}{4}\%$, and re-insured $\frac{2}{3}$ of it at 3% . The premium received exceeded the premium paid by \$144. Find the amount of the risk.
6. A man has property insured for \$4,325, for which he paid \$129.75 premium. He wishes to increase the policy to \$6,600; what extra premium will he be required to pay if the rate for the latter is $\frac{1}{4}\%$ greater?
7. For what sum must I insure my house worth \$2,450 at 2% so as to recover, in case of loss, both value and premium?
8. What will be the cost of insuring a property worth \$47,500 at the rate of $\frac{1}{4}$ of 1% , so that in case of loss the owner may recover both the value of the property and the premium paid?
9. What will be the cost of insuring a ship worth \$486,250 at $3\frac{1}{4}\%$, so that in case of loss the owner may recover the value of the ship, and the amount paid for insurance?

10. A merchant bought 20,000 bushels of wheat and had it insured for $\frac{1}{4}$ of its cost, at $1\frac{1}{2}\%$, paying a premium of \$136. At what price per bushel must he sell it to gain 20% of the cost of the wheat?
11. A dealer shipped 200 bbls. of apples to Liverpool; the average cost of the apples was \$6.75 a bbl.; for what sum must he have the apples insured at 1% premium to guard against all loss in case of shipwreck, his other expenses being \$25?
12. A company took a risk at $1\frac{1}{2}\%$; re-insured 60% of it at $1\frac{1}{2}\%$, and 40% of the remainder at $1\frac{1}{2}\%$. What rate did the company receive on the amount of risk it carried?
13. A merchant had 450 bbls. of flour insured for $\frac{1}{4}$ of its value at $2\frac{1}{2}\%$, paying \$45 premium. At what price per bbl. must he sell it to gain 25% of the prime cost as well as of the premium paid?
14. A cargo worth \$2,250 is insured for 80% of its value; the premium paid was \$24; find the rate.
15. An insurance company took a risk at $2\frac{1}{2}\%$, and re-insured $\frac{2}{3}$ of the risk at 2%. The premium received exceeded the premium paid by \$45; find the amount of the risk.

XVI.—DUTIES AND CUSTOMS.

A.

What is the specific duty on:

1. 12 chests of tea, net weight 705 lbs., at 2c. per lb.?
2. 147 gals. of oil at 12c. per gal.?
3. 50 pieces at \$35 each?
4. 4 hhds. sugar, each weighing 1,200 lbs., at 10c. per lb., allowing tare 6 lbs. per 100?
5. 5 bags of rice, each weighing 75 lbs., at 15c. per lb., allowing 4% for tare?
6. 3 hhds. sugar, each weighing 1,200 lbs., at 10c. per lb., tare 14%?

IX.—MISCELLANEOUS EXERCISES ON DECIMALS.

A.

Find the value correct to 5 dec. places of :

$$1. \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5} + \frac{1}{6} + \dots$$

$$2. \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5} + \frac{1}{6} + \dots$$

$$3. \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5} + \frac{1}{6} + \dots$$

$$4. \frac{1}{1} + \frac{1}{5} + \frac{1}{5^2} + \frac{1}{5^3} + \frac{1}{5^4} + \frac{1}{5^5} + \dots$$

$$5. \frac{1}{1} + \frac{1}{6} + \frac{1}{6^2} + \frac{1}{6^3} + \frac{1}{6^4} + \dots$$

Find the value correct to 4 places :

$$6. 1 + \frac{1}{1} + \frac{1}{1 \times 2} + \frac{1}{1 \times 2 \times 3} + \frac{1}{1 \times 2 \times 3 \times 4} + \dots$$

$$7. 1 + \frac{1}{1} + \frac{1}{1 \times 3} + \frac{1}{1 \times 3 \times 5} + \frac{1}{1 \times 3 \times 5 \times 7} + \dots$$

$$8. \frac{1}{5} + \frac{1}{3 \times 5^2} + \frac{1}{5 \times 5^3} + \frac{1}{7 \times 5^4} + \dots$$

9. Reduce to a decimal

$$2 + \frac{1}{2 \times 3} + \frac{1}{2 \times 3 \times 4} + \frac{1}{2 \times 3 \times 4 \times 5} + \frac{1}{2 \times 3 \times 4 \times 5 \times 6} + \dots$$

10. Reduce to a decimal

$$2 + \frac{1}{2 \times 4} + \frac{1}{2 \times 4 \times 6} + \frac{1}{2 \times 4 \times 6 \times 8} + \frac{1}{2 \times 4 \times 6 \times 8 \times 10} + \dots$$

1. Simplify $\frac{.51 \text{ of } (.00817 - .00557) + (.357 \times .007)}{.51 \times .17}$

2. Find the difference between $\frac{\frac{1}{2} \text{ of } .005}{\frac{1}{2} \text{ of } .345}$ and $\frac{\frac{1}{2} \text{ of } (\frac{1}{2} - \frac{1}{10})}{.72 + \frac{1}{10}}$

3. Simplify $(.357 - .255)^2 + \frac{1}{2} (.357)^2 - (.255)^2$

4. Simplify $\frac{1}{2} (.085)^2 + (.014)^2 + \frac{1}{2} (.085)^2 - (.085)(.014) + (.014)^2$

5. Reduce to its simplest form:

$$\frac{(.05)^4 - (.025)^2(.0125)^2 - (.0375)^4}{(.0375)^2 - (.05)^2(.0125) - (.025)(.0125)^2}$$

6. Express as a vulgar fraction the average of

$$\frac{1}{2}, \frac{1}{3}, .7, .4\frac{1}{2}, \text{ and } .455\frac{1}{2}$$

7. Find the average correct to 4 dec. places of $12\frac{1}{2}$, 21, $7\frac{1}{2}$, .034, 3.125, 0, 24.58 and $12\frac{1}{2}$.

8. Prove that $.48732 = .48732$

9. Reduce to a simple quantity

$$\frac{1.8 \text{ of } 2.37}{1.136} + \frac{4.4 - 3.83}{1.6 + 2.628} \text{ of } \frac{6.8 \text{ of } 3}{2.25}$$

10. Simplify $3.875 \times 2.5 + 5.68 \times \frac{15.25}{2.05}$

11. Find the simplest form of

$$\frac{1}{2} (2.5 + 1.12 + .32) \times (7.24574 - 2.634) \frac{1}{2} + 110.8$$

12. The average of four quantities is $15\frac{1}{4}$; the first is 24.207, the second is 3.592, and the third is 98.06. Find the fourth.

X.—PERCENTAGE.

A.

1. How much is 5% of 360; 4% of 132; 6% of 6643; 7% of \$316; 9% of \$745?
2. Find $12\frac{1}{2}\%$ of 608 men; 20% of 975 bee.; $25\frac{1}{2}\%$ of 173 inches; $62\frac{1}{2}\%$ of 4840 sq. yds.; 8% of 5475 horses.
3. A clerk received \$375 a year, and had his salary raised 40%. What does he receive now?
4. A lawyer collected \$2346, and charged 5% for his services. How much money did he pay over?
5. Property which cost \$2,366 increased in value 18%. Find the present value.
6. The rent of a house is \$375, which is 11% of its value. What is the value?
7. A merchant sold \$3750 worth of goods, and had 25% of his stock left. What was the entire stock worth?
8. Ten years ago the population of a town was 6640. It has increased 20%. What is the present population?
9. What number increased by 18% of itself is equal to 177?
10. What number diminished by $14\frac{1}{2}\%$ of itself is equal to 738?
11. A farm was sold for \$6970, which was $16\frac{1}{2}\%$ more than it cost. Find the cost.
12. The number of boys in a school is 20% of the number of girls. The number of boys is 175; how many pupils are there in the school?

B.

1. A man sold a lot for \$643, gaining $17\frac{1}{2}\%$ of the purchase price. What would he have sold it for had he gained 25% of the cost?

2. A merchant's bill for \$1000 was paid, but the amount of the bill was changed 2% at the merchant's request. How many cents in the dollar is the bank owing him to pay?
3. If 2 gal. of water are added to 48 gal. of wine, what per cent. of the mixture is water?
4. How much water will dilute 12 gal. of spirits 61% strong to 50%?
5. In an examination of 250 candidates, $12\frac{1}{2}\%$ of the whole obtain honors, and 60% of the remainder pass. How many fail to pass?
6. The demand of 10 hours' pay for 9 hours' work is equivalent to a demand of what increase per cent. in wages?
7. A grocer sells 11 lbs. of sugar for \$1, but the cost of sugar advances 10%; how many lbs. can he now sell for the dollar?
8. A man who owned $57\frac{1}{2}\%$ of a mine sold 45% of his share for \$27,000; what was the value of the mine?
9. A's money is $33\frac{1}{3}\%$ more than B's; how much per cent. is B's of A's?
10. One sixth is what per cent. of three-fourths?
11. A speculator sold a house for 34% profit, and with the money purchased another, which he sold for \$4,020, losing 16%. What did the first house cost him?
12. A bankrupt was able to pay 40% of his debts, but not a debt of \$500 proved worthless; now he is able to pay only 24c. on the \$. Find the total amount of his liabilities.

Q.

1. One number is double another; $12\frac{1}{2}\%$ of the greater and $16\frac{2}{3}\%$ of the smaller make 30. Find their sum.
2. A bankrupt pays 40% of his debts; the amount that a creditor receives is what per cent. of that which he lends?

3. Divide \$916 among A, B and C, so that 5% of A's share may equal $7\frac{1}{2}\%$ of B's, and 12% of B's may equal 20% of C's.
4. A bankrupt had goods worth \$7,000, which, if sold at their full value, would give his creditors 61% of their claims. But $\frac{1}{3}$ of them were sold at 7% below their value, and the remainder at 33% below their value. How many c. on the \$ did his creditors realize?
5. State the relation between the pound troy and the pound avoirdupois. What is the gain per cent. when the selling price per ounce avoirdupois is the same as the cost per ounce troy?
6. A dealer sells goods $6\frac{1}{2}\%$ below the marked price, and still gains 25%. Find the marked price of goods that cost \$1.32 a yard.
7. For each of three succeeding months the population of a western town rose 50%; and at the end of the third month it was 2,700. What was the population at the beginning of the time?
8. A sold a lot of goods to B, B disposed of them to C, and C sold them to D for \$62.37. A made 8%, B 10%, and C 15%. What did the goods cost A?
9. A man in building a house pays three times as much for material as for labor; had he paid $3\frac{1}{2}\%$ more for material and 9% less for labor his house would have cost \$7 more than it did. What was the cost of the house?
10. A merchant marked his goods at an advance of 25%, but in selling them he used a yard measure half an inch too short; his entire gain being \$37.24. Find the cost price of the goods.
11. In an examination, arithmetic and grammar are valued at 200 marks each; education, history and geography at 150 marks each. A candidate obtains 70% in arith., 65% in gram., 90% in education, 50% in history and 40% in geography. Find his average rate per cent. (of the aggregate).

12. A grocer has 150 lbs. of tea, of which he sells 60 lbs. at 50c. a lb., and gains only 8%. He now raises the price so as to gain 20% on the whole outlay; what does he now sell at per pound?

XI.—TRADE DISCOUNT.

A.

Find the buying price:

1. List price, \$253, Trade discount, 10% off.
2. List price, \$437, Trade do. 8% off.
3. List price, \$798, Trade do. 15% off.
4. List price, \$496, Trade do. 20 and 5 off.
5. List price, \$760, Trade do. 30 and 5 off.
6. List price, \$680, Trade do. 10 and 4 off.
7. Invoice price, \$1,000, Discount 10 and 5 off.
8. Invoice price, \$1,728, do. 12½ and 4 off.
9. Invoice price, \$2,040.90, do. 10, 5, and 3 off.
10. Invoice price, \$604.36, do. 20, 5, and 2½ off.
11. Invoice price, \$1,213.50, Discount 20, 10 and 3½ off.
12. Invoice price, \$373.20, do. 25, 16½ and 12½ off.

B.

1. After a discount of 15% had been allowed, a grocer paid \$798 for a bill of goods; what was the cost?
2. A merchant paid \$459 for a bill of goods after being allowed 36½ discount. Find the rate of discount.
3. At what price must a suit of clothes which cost \$12 be marked, so that after a discount of 5% is allowed there may be a gain of \$3.20.
4. A retailer bought a lot of carpet for 90c. a yard, at a discount of 10%. He received a further discount of 2% for cash; what did the carpet cost him per yard?
5. What is the difference between 20% off, and 15 and 10% off, the marked price being \$1.20?

6. A merchant marks his goods at an advance of 10% and allows 5% off for cash. Find the cash price of an article of which the cash price is \$7.41.
7. What rate of discount is equivalent to giving an ounce of sugar with each pound for good weight?
8. What rate of discount is equivalent to giving one bush with each yard for good measure?
9. A grocer mixes a pint of water with every gallon of vinegar. What trade discount will this enable him to give?
10. At what advance on cost must a merchant mark his goods, so that he may allow a discount of 33 $\frac{1}{3}$ % and still gain 33 $\frac{1}{3}$ %?
11. What is the difference between 30% discount, and 10, 5 and 5% off?
12. A merchant gives a discount of 10%, but uses a bad measure $\frac{1}{2}$ inch too short; what discount would allow him the same rate of gain if the measure was correct?

C.

1. What must I ask for velvet, which cost me \$8.41 a yard, so that I may fall 10%, and still make 20% after deducting 5% of the sales for bad debts?
2. A merchant reduced the marked price of an article by a certain per cent. He gives the same per cent. off this reduced price for cash. The cash price is now $\frac{1}{4}$ of the original marked price; find the rate per cent.
3. From the list price of a line of goods a purchaser is allowed a trade discount of 20%; a further discount of 10% off the trade price for taking a quantity, and a still further discount of 5% off this bill for cash. Find his gain per cent. by selling at 10% less than the list price.
4. A bookseller charges on certain books 5% on the selling of the published price and gives a discount of 35%. What is the actual rate he charges on the selling?

5. A merchant bought 250 yards of cloth at 25¢ per yard, and sold it at 30¢ per yard. What was his gain?
6. A merchant on March 1st, 1894, bought goods amounting, at catalogue prices, to \$240, on which he was allowed successive discounts of 33 $\frac{1}{3}$ % and 5%. The account is payable in 60 days, after which time interest is to be charged at 7% per annum. On June 1st, 1894, he paid \$100. How much is due on July 1st, 1894?
7. A bookseller gives a discount of 5% for cash, and school teachers a second discount of 10% on all cash prices. A teacher paid \$5.18 for a book; what was the marked price?
8. The marked price of certain goods was reduced on account of damage by fire; a further reduction of 12 $\frac{1}{2}$ % was given for cash. Goods that were originally marked \$5.40 were sold for \$4.20 cash; what reduction in the marked price was made?
9. A merchant bought a quantity of cloth, and marked it at an advance of 25%, and in selling it used a yard measure $\frac{1}{2}$ of an inch too long, his entire gain being \$132. Find the cost price and the discount the merchant gave.
10. A merchant marked his goods so as to gain 20%, but sold them for 5% less than his asking price. He gained altogether \$38.60; what did the goods cost?

XII.—COMMISSION.

A.

What is the commission for buying:

1. \$345 worth of goods, at 2% commission?
2. \$54.25 worth of goods, at 2 $\frac{1}{2}$ %?
3. \$405.50 worth of goods, at 1 $\frac{1}{2}$ %?
4. 75,440 lbs. of butter, at 16¢ per lb., commission 3%?
5. 712 bush. of flour at \$4.50, at 3%?

What is the commission for selling :

6. 3,945 bus. wheat at \$1.08, at $\frac{1}{2}\%$ commission?
7. A house and lot for \$4,850, at $2\frac{1}{2}\%$?
8. 420 acres at \$18.50, at $2\frac{1}{2}\%$?
9. A commission merchant sold 10,500 bus. of potatoes at 45c. a bus., on a commission of 2%; what was his commission?
10. An agent sold 1,500 bus. of oats at 28c. a bus., on a commission of $1\frac{1}{2}\%$. Find his commission.
11. A commission merchant sold a consignment of apples for \$1,756. What sum did he send his employer, his commission being $2\frac{1}{2}\%$?
12. A commission merchant retained \$5.85 from the proceeds of the sale of 1,625 lbs. of butter at 16c. per lb. Find the rate of commission charged.

B.

1. An agent's commission for selling some land at \$30 an acre was \$50; how many acres did he sell, commission at $\frac{1}{2}\%$?
2. \$1,648.27 includes the price paid by an agent for goods and his commission of $2\frac{1}{2}\%$. What was the cost of the goods?
3. A commission agent bought 13,450 bushels of wheat at 78c. a bus., and charged $1\frac{1}{2}\%$ for buying. How much must his employer send him?
4. A broker received \$11,500 to invest in pork at 5c. a lb. and pay his commission of 2%. How much pork did he buy?
5. A consignment of goods was sold for \$9,450; the agent paid \$225 for freight and other expenses, and remitted his employer \$9,067.50. Find the rate of commission.
6. An agent charges 2% for selling and 5% for guaranteeing payment; the sales amount to \$97. Find the amount the agent receives.

7. A commission merchant bought a lot, 20 bu. of wheat, with the money he realized from selling wheat at $2\frac{1}{2}\%$; the net proceeds of the wheat, after deducting the commission, being \$22,297.50. Find the price per bushel paid for the lot.
8. An agent sells 200 reapers for \$125 each. He is to be responsible for bad debts, which amount to 12 $\frac{1}{2}\%$ of the entire sale, and is to receive 20% of the good sales for his commission. What are his net earnings?
9. A firm became insolvent and owed \$4,050; their assets amounted to \$2,450.75. What per cent. of their indebtedness did they pay, having allowed the assignees $2\frac{1}{2}\%$ on the amount distributed for their services?
10. I received \$4,100 from my agent, who had deducted his commission at 5%, as proceeds of sale of goods; what were the goods sold for?
11. An agent sold, on a commission of $\frac{1}{2}\%$, a cargo of 1,200 tons of coal at \$4.75 per ton; he invested the net proceeds on a commission of 1% in lumber, at \$16 per M. How many feet of lumber did he buy?
12. A dealer shipped 400 bu. wheat at \$1.40, 300 bu. at \$1.62 $\frac{1}{2}$, and 500 bu. at \$1.20, to his agent, who sold the first at 20% gain, the second at 15% gain, and the third at 4% loss. The agent's commission was 3%, and the other charges were \$68.44; find the dealer's gain per cent.?

Q.

1. An agent sold a consignment of flour for \$4,800, and invested the proceeds (less his commission on both transactions) in the purchase of tea, receiving on the latter purchase 4% of the amount invested. His commission on both transactions being \$300, find the rate of commission on the sale of the flour.
2. A commission merchant received 125 bbls. of flour from A, 150 bbls. from B, and 225 bbls. from C; he finds on inspection that A's is 10% better than B's,

and $5\frac{1}{2}\%$ better than $1\frac{1}{2}\%$. He sells the whole lot at $\$7$ a bbl., charging 3% commission. What sum must he remit to each?

4. A cheese factory shipped 30,000 lbs. of cheese to Liverpool, which a commission merchant sold for 46s. 8d. per cwt. (112 lbs.). Find how many pounds per pound were realized on the cheese, the commission being 1% , and freight, insurance, etc., amounting to $\$36.30$ (£1 - $\$4.66\frac{1}{2}$).
5. A commission merchant sells a consignment of wheat for $\$27,500$, on a commission of $2\frac{1}{2}\%$. He pays $\$250$ for freight and storage, and with the net proceeds buys pork at $\$0.26$ per cwt., charging $2\frac{1}{2}\%$ for buying. How many cwt. of pork does he buy, and what is the amount of his two commissions?
6. A merchant shipped $\$2,550$ worth of barley to his agent, and received in return $\$2,435$ worth of tea. The agent charged a certain rate for selling, and 1 per cent. less than this for buying. Find the rates charged?
7. A commission merchant has goods consigned to him to sell, and, after deducting 2% for both selling and investing, he finds that his commission for selling exceeds his commission for buying by $\$6$. Find the value of the goods remitted to him.
8. An agent sold a consignment of apples on a commission of $\frac{1}{3}\%$. After deducting his commissions and reserving a sufficient sum to pay the freight at $1\frac{1}{2}\%$ per cwt., he bought flour at $\$2.75$ per cwt., on a commission of 2% . The total commission was $\$16.80$; find the amount of flour bought.
9. A commission merchant had shipped to him 500 bbls. of flour, and 5,000 bus. of wheat. He paid 30 a bbl. for the storage of the flour, 20 a bus. for the wheat, and $\$53.79$ for freight. He sold the flour at $\$5.50$ on a commission of 2% , and the wheat at 70 a bus. on a commission of 20 a bus.; what sum did he remit to his employer?

9. A commission merchant's terms are a certain rate of commission, with guaranteed payment of sales, or $2\frac{1}{2}\%$ without any guarantee. His employer accepts the former method (which is better than the latter by \$38, owing to a bad debt of \$84). If the total amount of sales was \$4,800, what was the guarantee per cent?
10. A merchant sent his agent \$5,075 with instructions to deduct his commission of $2\frac{1}{2}\%$, and invest the remainder in flour at \$6 a bbl. If the cost of freight and insurance amounts to \$125, at what must the flour be sold a bbl. to make a clear profit of 15% ?
11. A tradesman sends \$398.90 in cash and butter to his agent, with instructions to sell the butter and invest the proceeds, less his commissions, in tea. The agent charges $8\frac{1}{2}\%$ on the goods he handles in each case; find the value of the butter shipped if his total commission amounts to \$39.90.

XIII.—LOSS AND GAIN.

A.

Find the selling price:

1. Cost \$674, gain $12\frac{1}{2}\%$.
2. Cost \$712.40, gain $16\frac{1}{2}\%$.
3. Cost \$1,024.16, gain $37\frac{1}{2}\%$.
4. Cost \$1,250, loss 5% .
5. Cost \$1,348.75, loss 4% .
6. 18 bbls. flour @ \$5.80, gain 30% .
7. 482 bu. oats @ 31c., gain 25% .
8. 18 parlor sets @ \$42.75, gain $33\frac{1}{2}\%$.
9. 24 pieces print, 48 yds. each, @ 54c., gain 25% .
10. 425,250 ft. hemlock @ \$22 per M., loss 6% .
11. 19 bbls. sugar @ \$7.50, gain 2% .
12. A man invests \$2,500 and sells at a loss of 17% ; how much has he left?

13. A grocer bought coffee at 42c. per lb., and sold at a loss of $12\frac{1}{2}\%$. Find the selling price.
14. A grocer sold goods to the amount of \$24.00, and gained $16\frac{1}{2}\%$. Had he gained 30% find what the goods would have sold for?
15. A newsboy buys papers for 3c. a dozen, and sells them for a cent each. Find his gain per cent.

B.

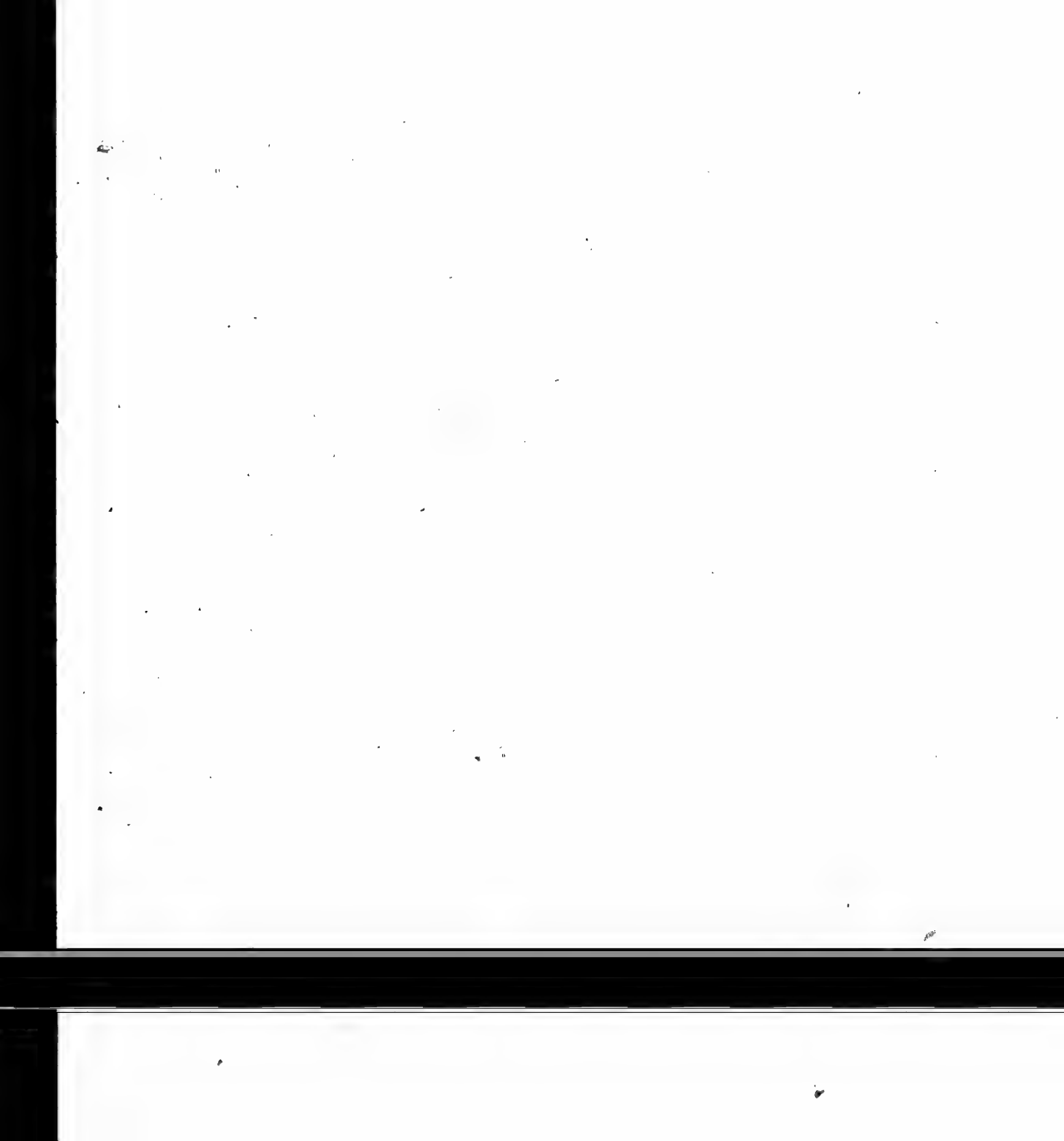
1. A market woman buys apples at the rate of 100 for 40c.; 10% of her apples is lost by decay. What per cent. does she gain by selling 5 for 3 cents?
2. When milk is sold at the rate of 20 quarts for \$1, there is a gain of 20%; what would be the gain if 16 quarts were sold for the same sum?
3. A grain merchant bought wheat and sold at a gain of $12\frac{1}{2}\%$; reinvested the whole sum and made the same rate of gain; reinvested again and lost 25%. Find total gain or loss.
4. If 15% is lost when an article is sold for \$2.04, for what should it be sold to gain 15%.
5. A sells a piano to B at a gain of 25%; B sells to C at a gain of 20%; C buys for \$180 more than A. What did the piano cost A?
6. A machinist sold two seed drills for equal sums of money. He gained 25% on the one and lost 25% on the other, his total loss was \$9.60; find the cost of each seed drill.
7. A man bought a bankrupt stock at 65c. on the \$ of the invoice price, which was \$4,840. He sold half of it at 10% advance on invoice price, half the remainder at 20% below the invoice price, and the balance at 50% of the invoice price. His expenses were 10% of his investment. Find his loss or gain, (a) in money, and (b) in rate per cent.
8. A grocer retailing sugar at the rate of 25 lbs. for \$1 makes a profit of $11\frac{1}{2}\%$. If a bbl. of sugar costs

\$11.35 and contains 300 lbs., what per cent. of the weight is lost in retailing?

9. A farm cost $3\frac{1}{2}$ times as much as a house; by selling the house at 10% loss, and the farm at $7\frac{1}{2}$ % gain, \$3,000.00 is received. Find the cost of each.
10. I bought 84 yards of cloth at \$5.70 a yard. It shrank 5% in length, find the selling price per yard to gain 30%.

C.

1. A bookseller deducts 10% from the marked price of his books, and after this has a gain of 25%. He sells a book for \$7.20; find the cost price of it, and what per cent. the marked price is in advance of the cost price.
2. A man sold 2 horses for \$120 each; on the one he gained 15%, and on the other he lost 15%. What per cent. did he gain or lose?
3. A merchant bought sugar at \$3.75 per cwt., and paid for freight and other charges $\frac{1}{2}$ of a cent per lb. How many lbs. can he sell for a dollar to make a clear gain of 25%?
4. A merchant bought 134 yds. of cloth at \$3.62 $\frac{1}{2}$ per yd., and 87 $\frac{1}{2}$ yds. at \$4.12 $\frac{1}{2}$ per yd. At what price per yd. must he sell the whole to realize a profit of 20%?
5. A merchant bought cloth at \$2 per yard, and sold the whole at a profit of \$120; had he sold it at 20% less he would have lost \$96. How many yards did he buy?
6. Instead of a yard measure a draper uses a stick which is 36.35 inches long. What does he lose per cent. by doing so?
7. How much per cent. does a grocer gain or lose by selling half a bbl. of sugar, giving only 15 ozs. to the pound, and the other half giving 17 ozs. to the pound?
8. A speculator sold a piece of land at a profit of 50%, but the buyer becomes bankrupt, and pays only 75c.



on the dollar. What per cent. does the speculator gain or lose?

9. A tailor buys cloth at \$1.75 a yard, which in washing shrinks 5%. At what price per yard must he sell it to gain 20% on his outlay?
10. A druggist gives a pound troy of certain goods for a pound avoird. Find his gain per cent. and the buyer's loss per cent.

XIV.—TAXES.

A.

Find the taxes on:

1. Assessed value \$3,700, rate $1\frac{1}{2}\%$.
2. Assessed value \$2,500, rate $1\frac{1}{2}\%$.
3. Assessed value \$8,500, rate $1\frac{1}{2}\%$.
4. On \$2,537 at 2c. on the \$.
5. On \$3,642 at $1\frac{1}{2}$ c. on the \$.
6. On \$3,900 at 15 mills on the \$.
7. On \$6,300 at 17 mills on the \$.
8. On \$3,240 at $17\frac{1}{2}$ mills on the \$.
9. When the rate of taxation is 15 mills on the dollar, what is the tax on property assessed at \$2,500?
10. The total assessed value of the property of a village is \$650,000. What tax will be raised at the rate of $12\frac{1}{2}$ mills on the dollar?
11. A tax of \$100,000 is to be levied on a county having rateable property to the value of \$3,790,000; what is the amount borne by A whose property is valued at \$7,500?
12. A tax of \$5,900 is levied for building a schoolhouse. The assessed value of the town is \$2,542,000; what does a man pay whose property is assessed at \$5,000?
13. What sum must be assessed on a school district to build a schoolhouse worth \$2,175, and pay 5% for collection?

14. A's income is \$300. What tax does he pay, \$400 being exempted, and the rate 15 mills on the dollar?
15. Find the net income of a man whose total income is \$925, on \$525 of which he pays a tax of 15 mills on the dollar.

B.

1. A tax of \$36,750 is to be levied on a town, the assessed valuation being 1.5 mills on the dollar; what tax does a man pay on an income of \$1,100, of which \$400 is exempted?
2. A farmer, whose property is assessed at \$9,000, pays on the dollar $1\frac{1}{2}$ mills for township rates, $1\frac{1}{2}$ for county rates, $1\frac{1}{2}$ for railway bonus and $2\frac{1}{2}$ for school rate. How much does he pay in all?
3. A man after paying an income tax of $15\frac{1}{2}$ mills on the dollar, and spending \$3.37 $\frac{1}{2}$ per day on an average, is able to save \$1,350.87 $\frac{1}{2}$ per year (365 days). Find his gross income?
4. The expense of constructing a bridge was \$5,000, which was raised by a tax on the assessable property of a town. The rate of taxation was 25 on the \$, and the collector's commission was \$100. Find the assessed value of the town property.
5. The net amount received by a village for taxes is \$9,177. The rate of taxation is 17 $\frac{1}{2}$ mills on the \$, and the collector's charges 5% of the total taxes. What is the amount of the assessment?
6. A farmer pays \$56.70 taxes on property worth \$5,000 which is assessed for $\frac{2}{3}$ of its value. Find the rate.
7. At a 14-mill rate, a man who has \$400 of his salary exempt, pays \$5.60. What was his salary?
8. A citizen, whose property is assessed for \$5,200, pays on the dollar for interest and other charges on general city debt 1.75 mills, for interest and other charges on Public and High Schools 3.43 mills, for Administration of Justice 2.00 mills, for Free Library rate 2.00 mills, for Street and Sewer 2.00 mills, and for

Jan. 1, 1900, \$100 at 6% per
 year, the amount due on Jan. 1,
 1901, is \$106.00. The amount
 due on Jan. 1, 1902, is \$112.36.
 The amount due on Jan. 1, 1903,
 is \$119.90.

2. Suppose the amount due on Jan. 1,
 1901, is \$106.00. The amount
 due on Jan. 1, 1902, is \$112.36.
 The amount due on Jan. 1, 1903,
 is \$119.90. The amount due on
 Jan. 1, 1904, is \$127.69.

3. When is the balance of the following account due;
 and how much must be paid on Jan. 1, 1903, to
 balance this account, allowing interest at 6%?

Dr. HARRY DUNNAN Cr.			
1901		1902	
May 1, To balance at 30 days	\$100	May 30, By cash	\$100
May 15, " " 30 days	\$100	June 15, " "	\$100
June 15, " " 30 days	\$100		

10. Find the equated time for the payment of the follow-
 ing account:

Dr. HENRY H. DUNNAN Cr.			
1900		1900	
Jan. 1, To balance at 30 days	\$100	July 15, By cash	\$100
Jan. 15, " " 30 days	\$100	Aug. 15, " "	\$100
Jan. 30, " " 30 days	\$100	Sept. 15, " "	\$100
Feb. 15, " " 30 days	\$100		

11. Suppose the amount due on Jan. 1, 1901, is \$106.00. The amount
 due on Jan. 1, 1902, is \$112.36. The amount due on Jan. 1, 1903,
 is \$119.90. The amount due on Jan. 1, 1904, is \$127.69.

General City purposes 1.387 mills. How much does he pay in all?

9. A township has assessable property amounting to \$475,000, and on a $3\frac{1}{2}$ mill rate they raise \$1,500, after paying the collector's charges. What per cent. of the taxes did the collector receive?
10. A man bought a farm for \$4,500; at the end of 3 mos. he paid his taxes levied on $\frac{1}{2}$ of the purchased value at 18 mills on the dollar; in another 3 mos. he spent \$425 on improvements, and at the end of the year he sold the farm for \$6,000. Find his gain, money being worth 5 per cent.

XV.—INSURANCE.

A.

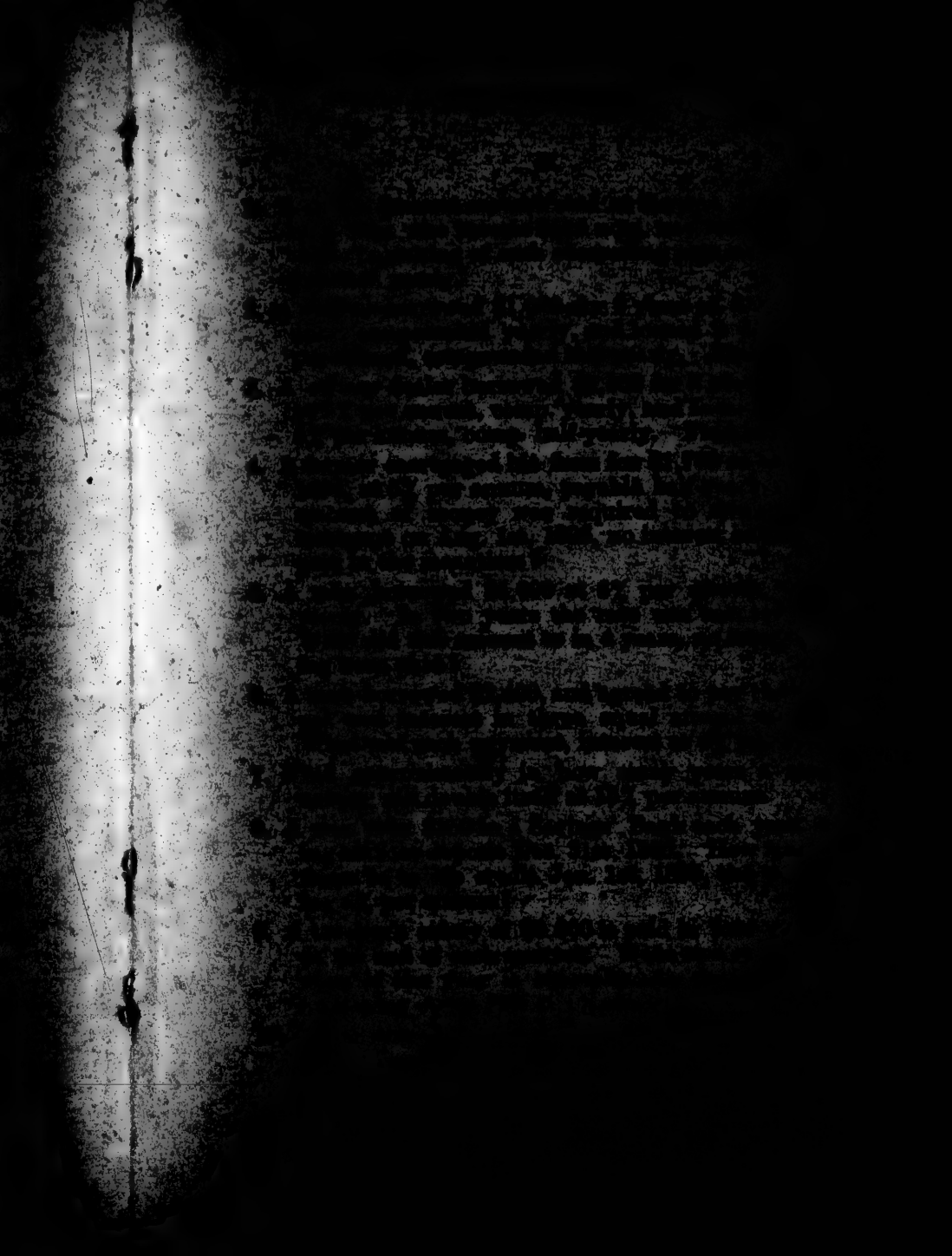
Find the premium of insurance on:

1. Policy \$1,200, rate $\frac{1}{4}\%$.
2. Policy \$6,000, rate $\frac{3}{8}\%$.
3. Policy \$3,600, rate $2\frac{1}{2}\%$ for 3 years.
4. Policy \$1,800, for 5 years, rate $\frac{5}{8}\%$ for each year.
5. Policy \$500, at 90c. per \$100 for 3 years.
6. Policy \$6,000, for 4 years, at $1\frac{1}{4}\%$ per annum.
7. Policy \$5,000, at 1.17%.
8. What will it cost to insure a mill worth \$15,000 for $\frac{1}{2}$ of its value at $1\frac{1}{2}\%$?
9. What is the premium for insuring 4,840 bus. wheat, valued at \$1.20 a bus., at $1\frac{1}{8}\%$ on $\frac{1}{2}$ of its value?
10. A building was insured for \$2,500 in one company at $1\frac{1}{2}\%$, and for \$3,000 in another company at $1\frac{1}{2}\%$. What was the total premium?
11. Find the premium paid to insure a house worth \$7,500, for $\frac{1}{2}$ of its value, for 4 years, the rate being $\frac{1}{2}\%$ for each year.
12. A man insures a house worth \$4,000, for $\frac{1}{2}$ of its value, at 2% premium. If the house be destroyed,

find the total loss sustained by the owner after one premium has been paid.

B.

1. Find the premium paid to insure a horse worth \$7,500 for $\frac{3}{4}$ of its value, for 3 years, the rate being $\frac{1}{4}\%$ of the policy for each year.
2. A factory valued at \$17,600 is insured for $\frac{1}{2}$ of its value in two companies, the first taking $\frac{2}{3}$ of the risk at $\frac{1}{4}\%$, the second the remainder at $\frac{1}{4}\%$. Find the total amount of premium.
3. A vessel running between Oswego and Hamilton is insured for \$12,350 at the rate of $1\frac{1}{4}\%$ per month. To what does the premium of insurance amount from April 10th to November 10th?
4. An insurance company took a risk of \$9,600 at $2\frac{1}{4}\%$, and immediately re-insured $\frac{1}{2}$ of it in another company at 3%. If the property be destroyed find the loss sustained by each company.
5. A company took a risk at $3\frac{1}{4}\%$, and re-insured $\frac{1}{2}$ of it at 3%. The premium received exceeded the premium paid by \$144. Find the amount of the risk.
6. A man has property insured for \$4,325, for which he paid \$129.75 premium. He wishes to increase the policy to \$6,000; what extra premium will he be required to pay if the rate for the latter is $\frac{1}{4}\%$ greater?
7. For what sum must I insure my house worth \$2,450 at 2% so as to recover, in case of loss, both value and premium?
8. What will be the cost of insuring a property worth \$47,580 at the rate of $\frac{1}{2}$ of 1%, so that in case of loss the owner may recover both the value of the property and the premium paid?
9. What will be the cost of insuring a ship worth \$486,281 at $3\frac{1}{4}\%$, so that in case of loss the owner may recover the value of the ship, and the amount paid for insurance?



10. A merchant bought 20,000 bushels of wheat and had it insured for $\frac{1}{4}$ of its cost, at $1\frac{1}{2}\%$, paying a premium of \$136. At what price per bushel must he sell it to gain 20% of the cost of the wheat?
11. A dealer shipped 200 bbls. of apples to Liverpool; the average cost of the apples was \$2.75 a bbl.; for what sum must he have the apples insured at 4% premium to guard against all loss in case of shipwreck, his other expenses being \$25?
12. A company took a risk at $1\frac{1}{2}\%$; re-insured 40% of it at $1\frac{1}{2}\%$, and 40% of the remainder at $1\frac{1}{2}\%$. What rate did the company receive on the amount of risk it carried?
13. A merchant had 450 bbls. of flour insured for $\frac{1}{4}$ of its value at $2\frac{1}{2}\%$, paying \$45 premium. At what price per bbl. must he sell it to gain 25% of the prime cost as well as of the premium paid?
14. A cargo worth \$2,200 is insured for 80% of its value; the premium paid was \$24; find the rate.
15. An insurance company took a risk at $2\frac{1}{2}\%$, and re-insured $\frac{2}{3}$ of the risk at 2%. The premium received exceeded the premium paid by \$49; find the amount of the risk.

XVI.—DUTIES AND CUSTOMS.

A.

What is the specific duty on:

1. 12 chests of tea, net weight 785 lbs., at 5c. per lb.?
2. 147 gals. of oil at 12c. per gal.?
3. 50 pieces at \$25 each?
4. 4 hhds. sugar, each weighing 1,200 lbs., at 9c. per lb., allowing tare 6 lbs. per 100?
5. 6 bags coffee, each weighing 75 lbs.; at 25c. per lb., allowing 4% for tare?
6. 3 hhds. sugar, each weighing 1,200 lbs. gross, at 8c. per lb.; tare 14%?

Find the ad valorem duty :

7. Invoice \$1,000 at 15%.
8. Invoice, boots and shoes, \$769.40 at 15%.
9. Invoice, jewellery, \$5,227.00 at 25%.
10. On 225 doz. kid gloves at \$4.00 per doz., at 27%.
11. On 75 boxes of oranges at \$2.90 a box, at 15%.
12. On a book, invoice price \$4.00, at 15%.

B.

1. A dealer imports a book for me which was invoiced to him at \$1.75 ; he pays 14c. postage, 20% ad valorem duty and makes a gain of 25% on his whole outlay. What do I pay for the book ?
2. Find the duty at 10c. a lb., and 12% ad valorem, on 325 bags of wool, each weighing 86 lbs., and valued at 18c. a lb.
3. A fruit dealer imports 30 boxes of oranges, each box containing 260 oranges, at \$2.75 a box. The freight is \$13.20, the duty 15%, the broker's fee \$1.15, and the expense of delivery \$1.25. How much will be gained by selling the oranges at 28c. a dozen ?
4. A dealer in musical instruments sells at an advance of 35% laid down in his store. I pay him \$531.90 for a piano, on which he paid a specific duty of \$20 and an ad valorem duty of 15%, and \$20 for freight and cartage. What was the invoice price of the piano ?
5. A merchant pays \$1,055 duty on an invoice of goods. If 16½% of the goods be exempt from duty, and 24½% is charged on the remainder, find the invoice price of the goods.
6. The duty on rubber fire hose is 5c. a lb. and 15% ad valorem. The duty on 1,000 feet of hose, invoiced at 18c. per foot, was \$152.00 ; find its weight per foot.
7. 16% of a shipment of goods was admitted free of duty on account of damage received, and 25% was charged on the remainder. The duty amounted to \$222.00 ; what was the invoice price ?

21. A and B have a bank account. A deposits \$1000 and B deposits \$500. The account earns 4% interest. How much money will they have at the end of the year?
22. A and B have a bank account. A deposits \$1000 and B deposits \$500. The account earns 4% interest. How much money will they have at the end of the year?

XXIV. PARTNERSHIP.

1.

1. A and B form a partnership to carry on a dry goods business. A invests \$2,000 and B invests \$3,000. They make a gain of \$1,275 between them.
2. Two men jointly purchase a house, the one paying 60% of the purchase money, and the other 40%. They rent the house for \$120.00 a year. What part of the rent shall each have?
3. A, B and C gain \$12,771 in a speculation. A invested \$1,000, B \$1,500, C \$1,500. How much of the gain shall C get?
4. B and C agreed to do a piece of work for \$100. C worked 25 days of 8 hours each, and B worked 20 days of 8 hours each. How much was C paid?
5. Kent and Brown engaged in the lumber trade with a joint capital of \$10,000. At the end of the year Kent's gain amounted to \$1,710, and Brown's to \$1,290. How much capital did Brown put into the business?
6. A, B and C form a partnership. Their respective shares of one year's gain are \$4,150, \$3,000 and \$2,850. A invested \$500 less than B. How much did C invest?
7. Three persons go into a trade. A puts into the business \$10,000, B \$15,000 and C \$20,000. At the end of the year they have a gain of \$10,000. How much shall each get?

8. A duty on coffee at $12\frac{1}{2}\%$ in bags of 150 lbs; gross, and invoiced at 15c. a lb., was \$777.60, tare having been allowed at 4%. How many bags were there?
9. A grocer imported 120 cases of wine, with 36 bottles in each case. After 5% had been allowed for breakage, he paid an ad valorem duty of 20%; the freight and other expenses were \$73. The whole cost being \$4,177, what was the invoice price per bottle?
10. The duty on surgical instruments is 25% and 30% on the cases. A case of instruments was invoiced at \$109. The duty being \$28.45, find the invoice price of the instruments.

XVII.—STOCKS AND INVESTMENTS.

A.

What is the market value of

1. 72 shares of stock at 80?
2. 168 shares of bank stock at 75?
3. 197 shares of mining stock at par?
4. 213 shares of stock at 112?
5. 350 shares of stock at $103\frac{1}{4}$?
6. \$3,600 in the 3 per cents at 94?
7. \$4,000 in the $3\frac{1}{2}$ per cents at $98\frac{1}{2}$?
8. \$2,240 in the $6\frac{1}{2}$ per cents at $106\frac{1}{2}$?
9. \$7,300 in the 7 per cents at $6\frac{1}{2}\%$ premium?
10. 153 shares of stock at $7\frac{1}{2}\%$ discount?
11. 322 shares of 5% stock at $11\frac{1}{2}\%$ below par?
12. \$2,900 in the 5 per cents at $3\frac{1}{2}\%$ above par?

What will it cost to purchase

13. 98 shares in the 5 per cents at $79\frac{1}{2}$, brokerage $\frac{1}{2}\%$?
14. \$7,645 stock in the 6 per cents at $94\frac{1}{2}$, brokerage $\frac{1}{2}\%$?
15. $76\frac{1}{2}$ shares of 7% stock at $118\frac{1}{2}$, brokerage $\frac{1}{2}\%$?
16. £3,850 in the $2\frac{1}{2}$ per cents at $91\frac{1}{2}$, brokerage $\frac{1}{2}\%$?
17. \$2,600 railway stock at par, brokerage $\frac{1}{2}\%$?

What does a stockholder receive who sells

18. 25 shares bank stock at $131\frac{1}{2}$, brokerage $\frac{1}{2}\%$?
19. 18 shares in the 10 per cents at $137\frac{1}{2}$, brokerage $\frac{1}{2}\%$?
20. 125 Telegraph Co. shares at 84, brokerage $\frac{1}{2}\%$?
21. \$75,000 Central R.R. stock at $121\frac{1}{2}$, brokerage $\frac{1}{2}\%$?
22. \$14,400 of 5% stock at $2\frac{1}{2}\%$ discount, brokerage $\frac{1}{2}\%$?

Find the income from investing

23. \$504 in the 6 per cents at 84.
24. \$319 in the 7 per cents at $93\frac{1}{2}$.
25. \$4,788 in the $3\frac{1}{2}$ per cents at 105.
26. \$1,868.50 in 6% stock at 101.
27. \$4,147 in 4% stock at $72\frac{1}{2}$, brokerage $\frac{1}{2}\%$.
28. \$6,720 in $5\frac{1}{2}\%$ stock at $95\frac{1}{2}$, brokerage $\frac{1}{2}\%$.
29. \$3,475.50 in the 3 per cents at 92, brokerage $\frac{1}{2}\%$.

How much stock will

30. \$4,200 buy in the 4 per cents at 75?
31. \$2,963.50 buy in the 7 per cents at 117?
32. \$1,878.75 buy in the 8 per cents at $125\frac{1}{2}$?
33. \$2,190 buy in the 8 per cents at $91\frac{1}{2}$, brokerage $\frac{1}{2}\%$?
34. \$3,741 buy in the $3\frac{1}{2}$ per cents at $86\frac{1}{2}$, brokerage $\frac{1}{2}\%$?
35. \$4,706 buy in the 6 per cents at $90\frac{1}{2}$, brokerage $\frac{1}{2}\%$?

What per cent. is made by investing in the

36. 8 per cents at 120?
37. 5 per cents at 95?
38. $3\frac{1}{2}$ per cents at 75?
39. 7 per cents at $93\frac{1}{2}$, brokerage $\frac{1}{2}\%$?
40. $7\frac{1}{2}$ per cents at $96\frac{1}{2}$, brokerage $\frac{1}{2}\%$?
41. 9 per cents at $102\frac{1}{2}$, brokerage $\frac{1}{2}\%$?

How much stock must be sold in the

42. 6 per cents at 122 to produce \$361?
43. 6 per cents at $112\frac{1}{2}$ to produce \$343.75?

at does a stockholder receive who sells

25 shares bank stock at $131\frac{1}{2}$, brokerage $\frac{1}{2}\%$!
 18 shares in the 10 per cents at $137\frac{1}{2}$, brokerage $\frac{1}{2}\%$!
 125 Telegraph Co. shares at 84, brokerage $\frac{1}{2}\%$!
 \$75,000 Central R.R. stock at $121\frac{1}{2}$, brokerage $\frac{1}{2}\%$!
 \$14,400 of 5% stock at $2\frac{1}{2}\%$ discount, brokerage $\frac{1}{2}\%$!

d the income from investing

\$504 in the 6 per cents at 84.
 \$819 in the 7 per cents at $93\frac{1}{2}$.
 \$4,788 in the $3\frac{1}{2}$ per cents at 105.
 \$1,868.50 in 6% stock at 101.
 \$4,147 in 4% stock at $72\frac{1}{2}$, brokerage $\frac{1}{2}\%$.
 \$3,720 in $5\frac{1}{2}\%$ stock at $95\frac{1}{2}$, brokerage $\frac{1}{2}\%$.
 \$3,475.50 in the 3 per cents at 92, brokerage $\frac{1}{2}\%$.

w much stock will

\$4,200 buy in the 4 per cents at 75 !
 \$2,983.50 buy in the 7 per cents at 117 !
 \$1,878.75 buy in the 8 per cents at $125\frac{1}{2}$!
 \$2,190 buy in the 3 per cents at $91\frac{1}{2}$, brokerage $\frac{1}{2}\%$!
 \$3,741 buy in the $3\frac{1}{2}$ per cents at $86\frac{1}{2}$, brokerage $\frac{1}{2}\%$!
 \$4,706 buy in the 6 per cents at $90\frac{1}{2}$, brokerage $\frac{1}{2}\%$!

at per cent. is made by investing in the

3 per cents at 120 !
 5 per cents at 95 !
 $3\frac{1}{2}$ per cents at 75 !
 7 per cents at $93\frac{1}{2}$, brokerage $\frac{1}{2}\%$!
 $7\frac{1}{2}$ per cents at $96\frac{1}{2}$, brokerage $\frac{1}{2}\%$!
 9 per cents at $102\frac{1}{2}$, brokerage $\frac{1}{2}\%$!

r much stock must be sold in the

3 per cents at 123 to produce \$661 !
 6 per cents at $112\frac{1}{2}$ to produce \$843.75 !

XV.—EXCHANGE.

Find the cost of a draft in

1. New Orleans on Chicago for \$7,200 at $\frac{1}{2}\%$ premium.
2. St. Louis on St. Paul for \$4,700 at $\frac{1}{2}\%$ discount.
3. St. Louis on New York for \$3,500 at $\frac{1}{2}\%$ discount.
4. Toronto on New York for \$5,500 at $\frac{1}{2}\%$ premium.
5. Montreal on Chicago for \$3,625 at $\frac{1}{2}\%$ discount.

Find the cost of a bill of exchange in

6. New York on London for £250 (\$1—\$4.32).
7. Winnipeg on Liverpool for £425 10s. (\$1—\$4.97).
8. New Orleans on Glasgow for £500 (\$1—\$4.97).
9. How much must be paid for a sight draft on Vancouver for \$3,245 at $\frac{1}{2}\%$ premium?
10. What amount of bill of exchange on London can be bought for \$463.00 (\$1—\$4.60)?
11. Find the cost of a bill of exchange on Paris for 1,200 francs at 5.16 francs for \$1.
12. Find the value in English money of £264 10s. when the course of exchange between Paris and London is at 25.5 pence per pound sterling.
13. What will be the cost of a bill of exchange on Berlin for 4,500 marks, the rate of exchange being 100 marks per £ mark?
14. I purchase, through a New York broker, a bill of exchange on Manchester for £425 10s. \$1 at 4.97. What was the cost, brokerage $\frac{1}{2}\%$?
15. I sell, through a broker in Berlin, a bill of exchange on Hamburg for 1,500 marks at 20½ for £ mark. What did I receive, brokerage $\frac{1}{2}\%$?

NOTE.—Exchange quotations (when not given in the text)

- (1) usually give the value of £1 as a certain number of

44. 5 per cents at 101 to produce \$284.25 ?
45. U.S. (10-40's) at 82½ to produce \$2,350 ?
46. St. Paul R.R. stock at 69½, brokerage ½%, to produce \$11,000 ?

What sum invested gives an income of

47. \$320 in the 3 per cents at 120 ?
48. \$600 in the 6 per cents at 85 ?
49. \$2,500 in the 5% at 98½, brokerage ½% ?
50. \$672 in the 3½% at 82, brokerage ½% ?

B.

1. A broker invests \$5,934.50 in stock at 87, on ½% commission ; what are his charges ?
2. Find the alteration in income occasioned by shifting \$5,000 stock from the 3 per cents at 88½, to the 4 per cents at 114½, the brokerage being ½% on each transaction.
3. Find the income derived from \$22,851.50 invested in bank stock which sells at 124, and pays a dividend of 3% per annum, brokerage ½%.
4. Find the alteration in income occasioned by selling out \$4,500 stock in the New York Central paying 5% at 115½, and investing the proceeds in 3% Government bonds at 91½, brokerage ½% in each case.
5. Which is the better investment, 4% stock at 100, or 5% stock at 131 ; brokerage in each case ½% ?
6. Bought \$4,750 stock at 75 ; at what price per share must I sell it to gain \$190 ?
7. What rate per cent. do I receive on my money by investing in stock at 85½, brokerage ½, paying an annual dividend of 5% ?
8. What per cent. is made by investing in 4½% stock at 75 ?
9. What is the price of a 4½% stock which pays ½% on the money invested ?

10. What is the price of a 5% stock paying 42 on the money invested, brokerage 1%?
11. Sold stock at a discount of 17% and made 10% on my money; at what rate of discount did I buy?
12. If stock at 90% premium will pay 5% interest on the investment, at what premium would it have to be bought to pay 6% interest?

C.

1. A man owned 66,000 bank stock which paid a yearly dividend of 4%. He sold out at 102, and invested the proceeds in Michigan Central stock at 74, paying a yearly dividend of 8%. By how much was his yearly income changed by the transfer, brokerage 1% in each case?
2. M invested money in 8% consolidated stock at 96, and an equal sum in factory stock at 190 paying an annual dividend of 7%. From the latter he received \$10 a year more than from the former. How many fifty-dollar shares did he purchase?
3. A retired farmer invests 40% of his capital in 3% stock at 96, and the remainder in 4% stock at 95; his income is \$698 per year. What capital has he invested?
4. A man sold his 5 per cents at 75 and invested the proceeds in 6 per cents at 104. His change in income being \$324, find how much 5% stock he had.
5. A man invests \$6,000 in 5% stock at 120; at the end of one year, having just received the yearly dividend, he sells out at 131. How much better off is he than if he had loaned his money at 5% per annum?
6. What must be the market value of 6% stock, so that after paying an income tax of 14 m. on the \$4 it may yield 5% on the investment?
7. I bought a certain 4% stock at 75, and after a number of years sold out at 95, and found that I had made 7% per annum, simple interest. How long did I hold the stock?

8. If a 5% stock sells at 105, how much must be invested in it to yield a yearly income of \$794, after paying an income tax of 15 mills on the dollar, \$400 of income being exempted from taxation?
9. Having received a stock dividend of 8%, I find I am now the owner of 297 shares; how many shares did I own at first?
10. A man having a certain sum of money to invest has an opportunity of purchasing 7% stock at 96, but delays until it has risen to 110. What per cent. is his income lessened by not purchasing at the first price?
11. How many railway shares at 40% discount must be sold, in order that the proceeds invested in bank stock, which is 4% below par, and pays a dividend of 7%, may yield an income of \$1,660?
12. A man invests \$12,000 in 3% stock at 75; he sells out at 80 and invests $\frac{1}{2}$ of the proceeds in $3\frac{1}{2}$ % stock at 96, and the remainder in 5% stock at par. Find the change in his income.

XVIII.—SIMPLE INTEREST.

A.

Find to the nearest cent the simple interest on

1. \$375 for $2\frac{1}{2}$ years at 3% per annum.
2. \$279.40 for 3 yrs. 2 moa. at 6%.
3. \$631.90 for 3 yrs. 73 days at 8%.
4. \$1,406 from May 3rd, 1897, to Nov. 16th, 1897, at 8%.
5. \$1,275 from July 5th, 1894, to Jan. 16th, 1896, at 8%.
6. \$1,830.63 from Aug. 16th, 1895, to June 19th, 1896, at 7%.
7. On March 1st, 1896, Fred Harris gave his note for \$75, for 6 moa., with interest at 6% per annum till due, and then at the rate of 8% per annum till paid. The note was settled in full June 28th, 1897; find the exact amount paid.

SIMPLE INTEREST.

8. Find the rate when \$144 is the interest on \$2,000 for 1 year and 4 mos.
9. Find the rate when \$2,075 amounts to \$3,317 in 3 years.
10. The interest on \$340 for 511 days is \$53.86; find the interest on \$650 for 2 years at the same rate.
11. In what time will \$3,300 amount to \$3,830 at $7\frac{1}{2}\%$?
12. \$1,160 amounts to \$1,255.70 in a certain time at 9%; what would be the amount of \$532 for the same time?
13. The interest on \$1,805, loaned on May 14th at $5\frac{1}{2}\%$ per annum, is \$37.90 $\frac{1}{2}$; on what day was the money returned?
14. The half-yearly interest on a mortgage at 7% per annum is \$385. What is the face of the mortgage?
15. \$350 amounts to \$400 in a certain time; what sum will amount to \$400 in half the time?

B.

1. A money lender has \$1,500 out at 8% per annum, \$1,200 at $7\frac{1}{2}\%$, and \$1,000 at 6%; find the per cent. he receives on the average.
2. The amount of a sum of money at a certain rate is \$693.33 for 8 years, and \$640.80 $\frac{1}{2}$ for $5\frac{1}{2}$ years. Find the principal and the rate per cent.
3. At what rate per cent. will \$1,520 amount to \$1,733.75 in $2\frac{1}{2}$ years?
4. A person borrows \$500 on April 10th, and on June 22nd pays his debt with \$510.30. At what rate per cent. per annum was he charged interest?
5. Divide \$4,941 among A, B and C, so that nine months' interest on A's share at $3\frac{1}{2}\%$ per annum, nine months' interest on B's share at $3\frac{1}{2}\%$, and nine months' interest on C's share at $4\frac{1}{2}\%$, may all be equal.
6. In what time will \$30,441 gain \$2,310.10 if at the same rate the gain on \$24,944.10 for 1 year and 15

- \$178.99 is divided among 5 men, 3 women and 10 children, so that 2 men may get as much as 3 women, and 3 women as much as 2 children !
10. A man divided \$17,940 among his 3 sons, whose ages are 16, 18 and 26 years, in proportion to their ages ; three years afterwards he similarly divided an equal sum, and again after 3 years more ; how much did each son receive altogether ?

XXIX.—WORKING PROBLEMS.

1. A can chop 4 cords of wood in 3 days, B can chop as much in 3 days as A in 4 days. How long would both together be in chopping 20 cords ?
2. A did $\frac{1}{3}$ of a piece of work, B did $\frac{1}{4}$ of the remainder, C did $\frac{1}{5}$ of what was left undone by B, and D finished the work. How much should D get for his work if A receives \$8.40 for his ?
3. Three men, A, B and C, working together can do a piece of work in 10 days. They undertake the job and work on it for 4 days ; C then quits, and A and B finish the work in 10 days. If A could have done the whole work by himself in 30 days, in what time could each of the others have done it ?
4. A and B can do a piece of work in 8 days when the days are 12 hours long ; A by himself could do the work in 12 days of 16 hours each. In how many days of 14 hours long could B do the work ?
5. If 8 men and 5 boys mow $7\frac{1}{2}$ acres of grass in 3 days, and 6 men and 7 boys in another field mow 30 acres in 12 days, how long will it take these 14 men and 12 boys to mow 12 acres ?
6. If 2 men in 10 weeks of 5 working days each, working 12 hours a day, dig 11 cellars, each 20 ft. long, 16 ft. wide and 5 feet deep ; how many men will be required to dig 16 cellars, each 24 ft. square and 4 ft. deep, in 12 weeks of 6 days each, working 9 hours per day ?

days is \$2,000.00? What is the rate per cent per annum (1 year = 365 days)?

7. On Jan. 1st, 1896, a person borrowed \$2,445.50 at 6%, and promised to return it as soon as it amounted to \$2,600.91. On what day did the loan expire?
8. Bought 9,000 bus. wheat at \$1.12½ per bus. payable in 6 mos.; I sold it immediately for \$1.05 per bus. cash, and loaned the money at 10% per annum. Having received the money loaned in 6 mos. I paid for the wheat. What did I gain or lose by the transaction?
9. A man bought a house for \$4,200; what monthly rent will pay the taxes on $\frac{3}{4}$ of the value at 17½ m. on the \$, and also 5% on the money invested?
10. Bought goods at \$5.70 on 4 months' credit, and sold them immediately at \$5.12, on such a term of credit as made my immediate gain 6½%. Reckoning interest at 4% per annum, how long credit did I give?

XIX.—PARTIAL PAYMENTS.

NOTE.—Each partial payment must, at least, be equal to the accrued interest; otherwise it is added to the next payment.

1. Note.—Prin. \$300. Date, Jan. 1st, 1896. Time, 3 years.
Paid.—Jan. 1st, 1896, \$60; Jan. 1st, 1897, \$120.00.
How much was due Jan. 1st, 1898? Rate 6%.
2. Note.—Prin. \$450. Date, Mar. 3rd, 1896. Time, 2 years.
Paid.—Sept. 3rd, 1896, \$120.00; May 2nd, 1897, \$107.50.
How much is due Mar. 3rd, 1898? Rate 5%.
3. Note.—\$1,200. Date, Oct. 12th, 1896. Time, 1 year.
Paid.—Oct. 12th, 1896, \$1,000; April 12th, 1897, \$200.
How much remained due Oct. 12th, 1897? Rate 5%.
4. Note.—\$600. Date, May 5th, 1897. Time, 6 mos.

BANK DISCOUNT

- Paid.—July 9th, 1899; Aug. 31st, \$400; Oct. 2nd, \$150.
 How much is due at maturity (Nov. 6th, 1899)?
 Rate 8%.
6. Note.—Prin. \$500. Date, Oct. 1st, 1897. Time, 120 days.
 Paid.—Nov. 15th, 1897, \$110; Dec. 25th, 1897, \$230.
 How much is due at maturity? Rate 7%.
7. Note.—Prin. \$1,000. Date, Mar. 1st, 1898. Payable on demand.
 Paid.—June 1st, 1898, \$500; Sept. 1st, 1898, \$10;
 Jan. 1st, 1897, \$100; June 1st, 1897, \$400.
 How much is due June 1st, 1898? Rate 8%.
7. Mortgage.—\$3,400. Date, Sept. 15th, 1894. Rate 5%.
 Paid.—April 20th, 1895, \$300; July 2nd, 1895, \$600; July 2nd, 1896, \$1,000.
 How much discharged the mortgage on Jan. 2nd, 1897?
8. Note.—\$1,217.30. Date, June 2nd, 1895. Rate 6%.
 Paid.—July 17th, 1895, \$207.89; Oct. 6th, 1895, \$200.00; Dec. 11th, 1895, \$220.00; Mar. 20th, 1896, \$421.83.
 How much redeemed the note on Oct. 7th, 1896?
9. Mortgage.—\$500. Date, June 30th, 1898. Rate 7½%.
 Paid.—Sept. 11th, 1898, \$220; June 30th, 1897, \$150.
 How much paid the mortgage on Jan. 31st, 1899?
10. Note.—\$520. Date, Oct. 15th, 1896. Rate 6%.
 Paid.—Nov. 26th, 1896, \$47.50; Dec. 28th, 1896, \$102.93; Feb. 11th, 1897, \$216.18; June 6th, 1897, \$200.10; Sept. 2nd, 1897, \$163.25.
 How much redeemed the note on Nov. 11th, 1897?

XX.—BANK DISCOUNT.

Find to the nearest cent the proceeds of the following notes:

6. The sum of two numbers is 34, and their difference is 14. What are the numbers?
7. Divide \$12.48 between John and Thomas so that each may have \$1.27, 48 more than Thomas.
8. The sum of two numbers is 34, and their difference is 14. Four times the larger is how many times the smaller?
9. It takes 3046 rails for a 3-railed straight fence around a farm, the rails being 11 ft. long. If the length of the farm is 120 rods more than its breadth, how many acres does the farm contain?
10. Two men, by working together, can perform a piece of work in 16 days. If the job is worth \$224, and one man would do it 5 days less than the other, how should the money be divided?
11. The sum of two numbers is 4375; their product is 17; the difference between the other two is 100. What are the numbers?
12. A man rows down stream a distance of 36 miles in 4 hours and back again in 6 hours. Find his rate of rowing in still water.
13. A man rows down stream 24 miles in 5 hours and back again 3 hours to row up. Find the rate of the current.
14. A man can row 6 miles an hour in still water. One day he went 45 miles down with his gun, and rowed back a stream which flows at the rate of 3 miles an hour.



EXERCISES

1. Face, \$1,123.25, dated Feb. 15th, 1897, for 60 days. Discounted immediately at 6%.
2. Face, \$235, dated Jan. 15th, 1897, for 3 mos. Discounted Feb. 1st, 1897, at $6\frac{1}{2}\%$.
3. Face, \$137.50, dated April 1st, 1896, for 4 mos. Discounted June 4th, 1896, at 8%.
4. Face, \$480, dated Feb. 6th 1897, for 3 mos., with interest at 5%. Discounted Feb. 18th, 1897, at 6%.
5. Face, \$2,000, dated Mar. 4th, 1895, for 60 days, with interest at 6%. Discounted immediately at 8%.
6. Face, \$4,900, dated Aug. 25th, 1896, for 90 days, with interest at 7%. Discounted Sept. 1st, 1896, at 8%.
7. Face, \$730. Time, 3 mos. Date, Aug. 3. Discounted on Sept. 15th, at 7%.
8. Face, \$500. Time, 45 days. Date, May 16th. Discounted immediately, at 6%. This note bears interest at 7%.
9. Principal, \$480. Time, 3 mos. Date, Feb. 6th. Discounted Feb. 18th, at 6%. This note bears 5% interest.
10. A note of \$2,450, dated New York, June 1st, 1886, for 4 months, bearing interest at 6%, was discounted at a bank on Aug. 15th, at 8%. Find the proceeds paid by the bank.

B.

1. A buys 600 yards of silk at 95c. a yard, and sells it at once, receiving in payment a 90-days' note for \$700, which he at once discounts at a bank at 6% per annum. Find the gain.
2. A man got a 90-days' note for \$1,350 for a lot which cost \$1,200 cash just a year before. Money being worth 6%, find his net gain at the time of sale (360 days to the year; no days of grace).
3. A bill for \$253.08, dated Oct. 7th, and payable at Chicago in 3 mos. from date, was discounted in Detroit on Oct. 20th; the discount being at the

2. I want a note \$200, and give him my note for \$200, what must be the face of the note, so that when discounted at 11% per annum, I shall receive \$200?
3. For what sum must I draw my note, dated May 1st, for 30 days, so that when discounted at 11% per annum, the proceeds may be \$200?
4. On March 1st, a bank gives me \$200 for a note of \$200. What is the note due, interest 6%?
5. For what sum must a note be drawn on June 1st, 1897, payable in 90 days, so that when discounted on June 1st, at 6%, the proceeds will be \$75.00?
6. The discount on a note for \$5,000, which matured on Aug. 1st, and was discounted on June 1st, was \$40.00. Find the rate of discount.
7. What rate of interest is made by a bank which discounts a 30-day note at 6% per annum?
8. On July 10th, a banker discounts a note for \$200, made May 10th, at 6 mon., at the rate of 8% per annum. At what rate does he receive interest on his money?

XXI.—EQUATION OF PAYMENTS AND ACCOUNTS.

The interest on what sum for 1 day equals

1. The int. on \$100 for 4 days?
2. The int. on \$50 for 16 days?
3. The int. on \$120 for 12 days?
4. The int. on \$200 for 15 days?
5. The int. on \$300 for 27 days?

How many days for

6. \$50 equals the int. of \$200 for 1 day?

8. Simplify

$$(3x^2 - 4x + 5) - (2x^2 - 3x + 1)$$

9. Find the value of $(1)^2 + (2)^2 + (3)^2 + \dots + (10)^2$

10. Find the value of $1^2 + 1^2 + 1^2 + 1^2 + 1^2 + 1^2$

11. Simplify $(1)^2 + 2(1)^2(1) + 2(1)(1)^2 + (1)^2$

12. Simplify $(1)^2 - 2(1)^2(1) + 2(1)(1)^2 - (1)^2$

13. Find the value of $\frac{1}{1} + \frac{1}{1} + \frac{1}{1} + \frac{1}{1}$; also of $\frac{1}{1} - \frac{1}{1} + \frac{1}{1} - \frac{1}{1}$

14. Simplify
$$\frac{(1)^2 - (1)^2}{(1)^2 + (1)^2(1) + (1)^2(1)^2 + (1)(1)^2 + (1)^2}$$

15. Simplify $(1 - 1) \times (\frac{1}{1} + \frac{1}{1} + \frac{1}{1} + \frac{1}{1} + \frac{1}{1})$

16. Simplify $(1 + 1) \times (\frac{1}{1} - \frac{1}{1} + \frac{1}{1} - \frac{1}{1} + \frac{1}{1})$

17. Simplify $(1)^2 + (1 + 1 + 1)(1)^2 + (1 + 1 + 1 + 1)(1)^2 + \dots$

219. Find the value of (a) $(\frac{1}{1} + 1)^2 - (\frac{1}{1} - 1)^2$; (b) $(\frac{1}{1} + 1)^2 - (\frac{1}{1} - 1)^2$

Reduce to their simplest form:

$$19. 3 + 4 + 5 + 16 + 38 + 64 + 125$$

$$3 + 6 + 12 + 24 + 48 + 96 + 192$$

$$20. 3 + 6 + 12 + 24 + 48 + 96 + 192 + 384 + 768$$

$$3 + 6 + 12 + 24 + 48 + 96 + 192 + 384 + 768 + 1536 + 3072$$

XXXV.--SQUARE ROOT

Find the square root of:

$$1. 121$$

$$2. 144$$

$$3. 169$$

$$4. 196$$

$$5. 225$$

$$6. 256$$

$$7. 289$$

7. \$25 equals the use of \$2,000 for 1 day?
8. \$50 equals the use of \$400 for 64 days?
9. \$12.50 equals the use of \$100 for 32 days?
10. \$12.50 equals the use of \$50.16 for 24 days?
11. I loaned Mr. Smith \$300 for 4 months; for how many months should he loan me \$200 or balance the favor?
12. How many months' use of \$300 is equal to the use of \$240 for 10 months?
13. A loaned me \$50 for six mo., \$75 for 5 mo.; how much money loaned A for 1 month would balance the favor?
14. I loaned A \$100 for 3 mo., \$75 for 3 mo., and \$50 for 4 mo.; how much should A loan me for 1 month to balance the favor?
15. A person owes another \$50 in six mo., \$50 in 8 mo., and \$50 in 12 mo. At what time may all be paid together, without loss or gain to either party?

B.

1. A debt of \$500 is to be paid as follows: \$100 immediately, \$200 in 4 mo., and the balance in 6 mo. What should it be paid altogether?
2. I owe \$1,700 to be paid down, \$1,500 in 20 days, and \$1,700 in 40 days. For how many days must my note be drawn so that the whole may be paid in one payment?
3. Find the equated time of \$50 due in 3 mo., \$50 in 5 mo., and \$50 in 7 mo.
4. Find the average term of credit of \$350 due in 60 days, \$520 in 90 days, and \$175 in 30 days.
5. Find the equated date of payment. On Jan. 1st a merchant bought goods as follows: \$500 due in 60 days, \$200 in 40 days, and \$400 in 30 days.
6. A merchant bought goods from a wholesale house as follows: Nov. 22d, 1897, \$200 worth on 30 days.

PROBLEMS OF ACCOUNTS AND ARITHMETIC

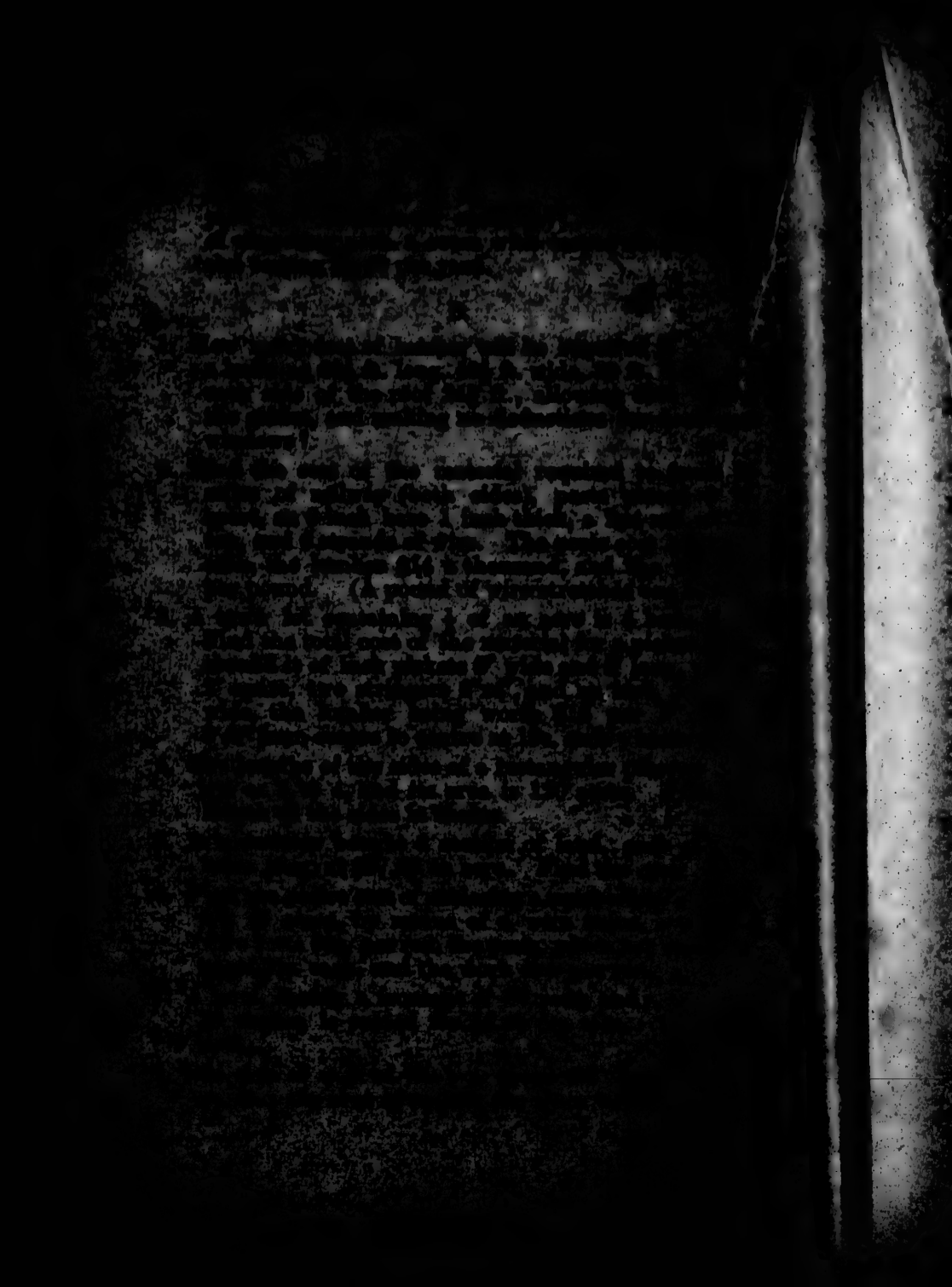
7. Find the equated time for the payment of the following account:
 Jan. 1st, 1897, \$500 on 30 days' credit;
 When may the merchant equitably pay the \$500?
8. Suppose that, from March 1st, 1897, to June 1st, 1897, the following bills were paid:
 Jan. 1st, 1897, \$200 on 30 days; Sept. 1st, 1897, \$300 on 30 days; and Oct. 1st, 1897, \$500 on 30 days. Find the equated time of payment.
9. Suppose that, from Jan. 1st, 1897, to Jan. 1st, 1898, the following bills were paid:
 Jan. 1st, 1897, \$500 on 30 days' credit; Feb. 1st, 1897, \$300 on 30 days; and Jan. 1st, 1898, \$200 on 30 days. Find the date from which the bills should be reckoned on the entire date of 1898.
10. When is the balance of the following account due; and how much must be paid on Jan. 1st, 1898, to balance this account, allowing interest at 6%?

Dr. HARRY CHURMAN Cr.			
1897		1897	
May 1.	To cash, at 30 days	\$500	May 20. By cash
May 15.	" " 30 days	\$200	June 15. " "
June 15.	" " 30 days	1000	

11. Find the equated time for the payment of the following account:

Dr.		HENRY H. BROWN		Cr.	
1898				1898	
June 20	To Cash @ 30 days	\$500	July 10	By Cash	\$1000
July 15	" " 45 days	200	Aug. 15	" " 300	
Aug. 15	" " 30 days	300	Sept. 15	" " 200	
Sept. 15	" " 30 days	150			

12. Suppose that, at 6%, what sum is due on Jan. 1st, 1897, on the following dollar account:



Arithmetic

To: **FRANK HARTMAN**

1897			1897		
Jan. 19	To mch.	30 days	120	Feb. 18	By cash
Feb. 8	"	60 days	150	April 20	"
March 8	"	30 days	400	June 24	"
April 4	"	30 days	300		
May 12	To cash		100		

XXII.—COMPOUND INTEREST.

A

Find the compound interest on—

1. \$100 for 3 years at 5% per annum, compounded yearly.
2. \$100 for 3 years @ 6% per an., comp. yearly.
3. \$100 for 3 years @ 8% per an., comp. yearly.
4. \$100 for 3 years at 4% per an., comp. yearly.
5. \$100 for 4 years at 5% per an., comp. yearly.
6. \$100 for 3 years at 5% per an., comp. half yearly.
7. \$100 for 3 years at 6% per an., comp. half yearly.
8. \$100 for 3 years @ 6% per an., comp. yearly.
9. \$100 for 10 years @ 6% per an., comp. quarterly.
10. \$100 for 3 years @ 4½% per an., comp. yearly.
11. \$100 for 3 years 3 mos. @ 4% per an., comp. yearly.
12. \$100 for 3 years 3 mos. @ 7% per an., comp. yearly.
13. \$100 for 3 years @ 7% per an., comp. half yearly.
14. \$100 for 10 years @ 5% per an., comp. quarterly.

1. A person borrows \$1,000 at 6% per annum, compounded annually. Find the amount due at the end of 5 years.
2. A money order borrowed \$2,500 at 6% per annum, compounded half-yearly. Find the amount due at the end of 3 years.
3. A person borrowed his farm for \$1,500 at 6% per annum, payable half-yearly. Find the amount of money required to redeem the mortgage on Aug. 1st, 1905, no interest having been paid in the meantime?
4. A man borrowed \$4,000 at 6% per annum, compounded annually. In two years the bank was told that \$1,000 of the amount was to be paid, and the balance was to be paid in 4 years, and the interest was to be paid in 4 years.
5. A man borrowed \$2,400, and agreed to pay the interest and principal in three equal annual payments. What was each payment, interest at 6% per annum?
6. Find approximately in how many years a sum of money will double itself at 12% per annum?
7. A man has \$500 in a Savings Bank each year he deposits \$100. How much will he have on Jan. 1st, 1905, the bank paying 4% per annum?
8. A woman's salary of \$2,000 is paid in four installments at the end of each quarter. What sum of money at the end of the year is equivalent to her salary?
9. A man has \$1,000 in a bank, and the bank pays 6% per annum.

12. A lent a sum of money for 3 years at 10% per annum, compounded yearly. B lent an equal sum for the same time at 10% per annum, comp. half yearly. B gained 220.35 more than A. Find the sum each lent.

XXIII.—PRESENT WORTH AND TRUE DISCOUNT.

Find the true present worth of :

1. \$240 due 3 years hence, money worth 4%.
2. \$3,025 due 3 years hence, money worth 7%.
3. \$1,375 due $2\frac{1}{2}$ years hence, money worth 4%.
4. \$912 due 4 years hence, money worth 5%.
5. \$1,120 due 16 mos. hence, money worth 5%.

Find the true discount on :—

6. \$272.50 due in 3 years, 5 mos., money worth 4%.
7. \$320.00 due in 3 yrs., 4 mos., money worth 4%.
8. \$1,320 due in 6 yrs., money worth 5%.
9. \$412.30 due in $2\frac{1}{2}$ years, money worth 3%.
10. \$225 due in 9 months, money worth 5%.
11. Find the P.W. of a note for \$900, payable in one year, money being worth 4%.
12. What sum will discharge a debt of \$1,500.00 to be paid in 3 mos., if money is worth 6%?
13. What is the T.D. allowed on a note for \$1,000.00 payable 10 mos. hence, money worth 5%?
14. A merchant bought goods amounting to \$210 on a credit of 4 mos.; the discount off is 4% for cash. If money is worth 9%, how much cheaper can he get the goods by paying cash?
15. A man rents a farm for 3 years, at \$441 per annum; the rent to be paid at the end of each year. Money being worth 5% per annum, comp. int. : find what sum would now pay the 3 years' rent.

16. A owes B \$200 due in 1 year, \$200 due in 2 years, and \$100 due in 3 years. What sum paid now would pay the debt, money worth 5% per an. comp. interest?
17. A gentleman had two sons aged 10 and 15 respectively. What sums must be deposited in a bank to date would now, so that each will receive \$2,500 when 21 years of age; money worth 4% per an. comp. interest?

XXIV.—PARTNERSHIP.

A.

1. A and B form a partnership to carry on a dry goods business. A invests \$2,000 and B invests \$3,000. They divide a gain of \$1,375 between them.
2. Two men jointly purchase a house, the one paying 66 $\frac{2}{3}$ % of the purchase money, and the other \$3,750. They rent the house for \$12.75 a year. What part of this ought each to have?
3. A, B and C gain \$12,771 in a speculation. A invested \$1,200, B \$1,500, C \$1,600. How much of the gain should C get?
4. B and C agreed to do a piece of work for \$300. C worked 35 days of 8 hours each, and B worked 20 days of 8 hours each. How much was C paid?
5. East and Brown engaged in the lumber trade with a joint capital of \$10,000. At the end of the year East's gain amounted to \$1,710, and Brown's to \$1,100. How much capital did Brown put into the business?
6. A, B and C form a partnership; their respective shares of one year's gain are \$2,150, \$2,450 and \$2,550. A invested \$250 less than B. How much did C invest?
7. A and B engage in trade. A puts into the business \$1,000, C puts in \$200 for 7 mo., B puts in \$300 for 10 mo. How much of the gain of \$500 is divided?

9. Base 12 ft., height 25 ft.
10. Base 1 yd., 1 ft., height 1 yd., 2 ft.
11. Base 5 yd., 3 ft., 5 ft., height 7 yd., 1 ft., 5 ft.

Find the area of triangles whose sides are

12. 20 in., 27 in., 75 in.
13. 20 ft., 40 ft., 112 ft.
14. 20 in., 20 in., 30 in.
15. 24 yd., 25 yd., 30 yd.
16. 312, 444 and 455.
17. 17, 69 and 73.

In right angled triangles whose

18. Base—6 ft., perpendicular—8 ft., find hypotenuse.
19. Base—40 ft., perpendicular—9 ft., find hypotenuse.
20. Base—15 ft., perpendicular—112 ft., find hypotenuse.
21. Perpendicular—18 ft., hypotenuse—65 ft., find base.
22. Base—15 yds., hypotenuse—17 yds., find perpendicular.
23. Hypotenuse—9.78 ft., perpendicular—8.6 ft., find base.
24. Two sides of a triangle are 25, 30 and 50 ft. respectively; find its area.
25. The sides of a triangular field are 312 yds., 360 yds. and 375 yds.; the field is rented at \$11 an acre; find the rent.

26. A footpath goes up the side and then along the end of a rectangular field 420 yards by 280 yards. What distance will be saved by cutting right across in the direction of the diagonal?
27. The sides of a triangle are 12, 16 and 18 ft.; find perpendicular length of the 16 ft. side from the opposite vertex; also find the area of each of the two triangles into which the triangle is divided.
28. Find the length of the diagonal of a square 24 ft. on a side.

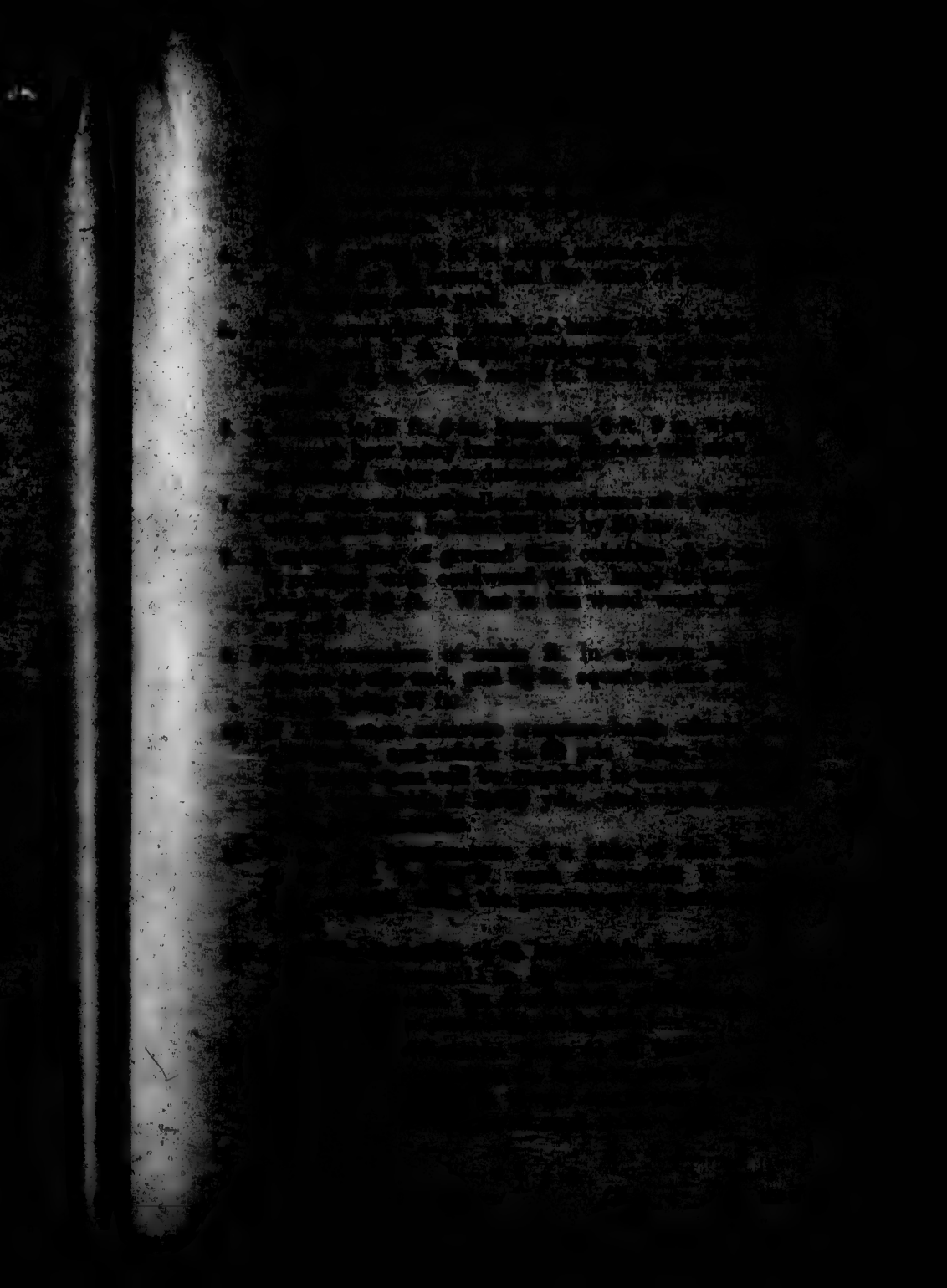
10. Three cattle buyers paid a bill for which they were to pay \$270; the first had to be paid for 12 days, the second to be paid for 15 days, and the third 20 days for 12 days. What should each pay?
11. Ray rented a house for one year for \$600; on the last of the month he took in Farmer for a certain number of months more they spent together. Farmer moved out two months before the year was up. How much of the rent did each pay?
12. A vessel worth \$2,700 is entirely lost; $\frac{1}{3}$ of it belongs to B, $\frac{1}{4}$ to C, and the rest to D. What did each lose, \$1,400 being received as insurance?
13. A, B and C entered into partnership, their money being in the business for 4 months, 4 months, and 8 months respectively. Their gains were \$450, \$300, and \$225 respectively. B's investment was \$2,000. What did A's and C's?
14. K and M made a joint stock of \$1,575, by which they gained \$387.50. K had for his share of the gain \$22.50 more than M; what did M contribute to the stock?

B.

1. A begins business with a capital of \$1,200; after 3 months B is admitted as partner with \$2,400; after 3 months more C is admitted with \$1,600. What portion of the year's gain should each have?
2. A, B and C rent a house for \$90. A pays for 8 weeks, B 12 and C 10 weeks. C 50 more for 12 weeks. If 5 cows are furnished on 3 cents and 1 cow on 2 cents, what should each pay?
3. A and B were employed to do a piece of work for \$100. They were to be paid in proportion to their share in work, which was 4 to 3, and to the time employed, which was 3 to 4. How much did each receive?
4. A and B entered into a partnership to carry on a certain business for one year. A put in \$1,000 and B \$2,000. At the end of 4 months, B withdrew \$500.

5. Three joined in a business and received of the
6. A and B \$4 \$2.50 143% a cow was A's 1 ager
7. A paid three and how
8. At the year's end \$240 against the 1 to his in 6 gain each
9. A and end \$4.00 the find
10. A and 60% the divid

- in 1900 at first and at the end of 4 months per cent. They gained \$2,000; find A's share.
5. Three persons, A, B and C, trade together, having a joint capital of \$4,700. A's money is in the business 6 mos., B's for 8 mos., and C's for 10 mos. Each receives \$600 as his share of the profit; how much of the capital did each contribute?
6. A and B engage in business, A contributing \$7,500, B \$4,500. The gross receipts for the first year were \$2,800, of which 5% was paid for insurance, and 14% for other expenses; of the balance B received a certain sum for managing the business, and the rest was divided in proportion to the capital invested. A's share was \$1,250; find B's allowance as manager.
7. A person in his will bequeathed all his property to his three children as follows: $\frac{1}{3}$ to John, $\frac{1}{4}$ to James, and $\frac{1}{5}$ to Mary. If his property was valued at \$7,425 how much should Mary get?
8. At the beginning of a year, A, B and C formed a partnership, contributing \$1,200, \$1,500, \$2,000, respectively. A acted as book-keeper at a salary of \$246, and B as manager on a salary of half as much again, both salaries to be increased in proportion as the business increased. After 2 mos. C added \$1,000 to his capital, after 4 mos. B added \$500 to his, and in 6 months' time A added \$300 to his. The total gain for the year was \$9,025.00; find the share of each.
9. A and B engage in trade, A invests \$6,000, and at the end of 5 mos. withdraws a certain sum. B invests \$4,000, and at the end of 7 mos. \$6,000 more. At the end of the year A's gain is \$5,800 and B's \$7,300; find the amount A withdrew.
10. A and B form a partnership, A supplying 25% more capital than B. At the end of the year A withdraws 60% of his capital, and B withdraws 40% of his. At the end of 2 years there is a gain of \$3,323.50 to be divided; how much does each receive?



XXV.—EXCHANGE.

Find the cost of a draft in

1. New Orleans on Chicago for \$7,200 at $\frac{1}{2}\%$ premium.
2. St. Louis on St. Paul for \$4,700 at $\frac{1}{2}\%$ discount.
3. Mobile on New York for \$2,000 at $\frac{1}{2}\%$ premium.
4. Toronto on New York for \$1,500 at $\frac{1}{2}\%$ premium.
5. Montreal on Chicago for \$1,025 at $\frac{1}{2}\%$ discount.

Find the cost of a bill of exchange in

6. New York on London for £330 (£1 = \$4.31 $\frac{1}{2}$).
7. Winnipeg on Liverpool for \$420 10s. (£1 = \$4.37 $\frac{1}{2}$).
8. New Orleans on Glasgow for £600 (£1 = \$4.37 $\frac{1}{2}$).
9. How much must be paid for a sight draft on Vancouver for \$3,240 at $\frac{1}{2}\%$ premium?
10. What amount of bill of exchange on London can be bought for \$468.99 (£1 = \$4.86)?
11. Find the cost of a bill of exchange on Paris for 1,775 francs at 5.16 francs for \$1.
12. Find the value in English money of 2,204.25 francs, when the course of exchange between Paris and London is at 25.5 francs per pound sterling.
13. What will be the cost of a bill of exchange on Berlin for 4,800 marks, the rate of exchange being 90 cents per 4 marks?
14. I purchase, through a New York broker, a bill of exchange on Manchester for £432 12s. 6d. at 4.21 $\frac{1}{2}$. What was the cost, brokerage $\frac{1}{2}\%$?
15. I sold, through a broker in Boston, a bill of exchange on Hamburg for 1,200 marks at 86 $\frac{1}{2}$ c. for 4 marks. What did I receive, brokerage $\frac{1}{2}\%$?

B.

NOTE.—Exchange quotations (when not given in \$ and c.) usually give the value of a £ as a certain per cent.

problem. The first one. When London is quoted at 100, Montreal is 110. When London is quoted at 100, Montreal is 110.

1. Determine the legal rate of exchange between the currency and Great Britain was \$4.44 for £1; the legal rate at present is \$4.86 for £1. Find what increase per cent. the present value is on the old value.
2. Find the cost of a 70-day bill of exchange on Liverpool for £240, exchange being quoted at 9½ (or par).
3. Find the cost of a demand-bill on London for £750, exchange at 9½.
4. Find the cost of a bill of exchange on Dublin for £316 15s., exchange at 10½.
5. What amount of demand-bill can be bought for \$2,500 exchange at 10?
6. What amount of bill of exchange can be bought for \$4,887, exchange at 9½?
7. What is the value of a 70-day draft on Chicago for \$5,000 at ½% premium, interest 6%?
8. I held a 70-day draft on Baltimore for \$2,750. I sold the draft at ½% premium, and with discount of 6% per annum. What did I receive?
9. A firm in Winnipeg bought a 60-day draft on Toronto for \$7,900 at ½% discount, rate of interest 5%. What was the cost of the draft?
10. What is the value of a 90-day draft on San Francisco for \$5,475, at ½% premium and interest 7%.

C.

1. A merchant in Montreal drew on Hamburg for 10,000 guilders at \$415. How much more would he have received if he had ordered remittance through London to Montreal, exchange at Hamburg on London being 1½ guilders for £1, and at London on Montreal 9½%, brokerage being 1½% for remittance from London?
2. An American tourist goes to Paris with \$5,000, which he changes for French money at the rate of 19½ cent.

17. Find the area of the curved surface of a cylinder whose height is 10 ft. and whose base has a circumference of 100 ft.

EXERCISES—THE CYLINDER

Form.—Surface = perim. of base $\times$ h. + twice area of base. Volume = area of base $\times$ h.

A.

Find the area of the curved surface of a cylinder

1. Height 5 in., circum. of base 19 ft.
2. Height 2 ft. 6 in., circum. of base 6 ft.
3. Height 1 ft. 10 in., circum. of base 4 ft. 4 in.
4. Height 20 ft., radius of base 2 in., $\pi = 3.1416$.

Find the area of the whole surface

5. Height 4 ft., radius 2 ft.
6. Height 3 ft., radius 2 ft. 6 in.
7. Height 2 ft. 6 in., diameter of base 20 ft.

Find the volume

8. Height 5 ft., height 7 feet.
9. Height 10 in., height 4 ft. 8 in.
10. Height 10 ft. 6 in., height 70 in.

11. A cylindrical can is 10 in. high and its top surface is a circle 10 in. long and 3 ft. in diameter.

12. The diameter of a well is 2 ft. 6 in. and its depth is 10 ft. Find the cost of lining the well with concrete at 10 cents per sq. ft.

13. A cylindrical tank is 10 ft. high and its diameter is 2 ft. 6 in. Find the cost of painting the tank at 10 cents per sq. ft.

B.

14. A cylindrical tank is 10 ft. high and its diameter is 2 ft. 6 in. Find the cost of painting the tank at 10 cents per sq. ft.

- for 1 franc. He spends 250 francs in France, and then goes to Vienna where he exchanges what he has left at the rate of 135 florins for 300 francs. He spends 500 florins in Vienna, and then goes to England, where he exchanges his money, getting 1s. 6d. for a florin. His outlay in England is £75 10s. How much American money has he left if \$1 = 94.00?
3. A merchant in Vancouver, British Columbia, owes \$4,000 in New York; exchange on New York is $\frac{1}{2}\%$ premium; but exchange on Chicago is $\frac{1}{2}\%$ discount, and from Chicago on New York $\frac{1}{2}\%$ premium. Compare the cost of a draft on New York direct, with that of one through Chicago which would pay the debt.
 4. A merchant in Quebec wished to remit 1,200 marks to Hamburg, and the exchange of Quebec on Hamburg was 35 cents for 1 mark. He found the exchange of Quebec on Paris was 18 cents for 1 franc; that of Paris on London was 25 francs for £1 sterling; that of London on Lisbon was 160 pence for 3 milrees; that of Lisbon on Hamburg was 5 milrees for 10 marks. He chose the circuitous exchange. What was his gain?
 5. When the course of exchange between London and New York is quoted at 4.96 $\frac{1}{2}$, London exchange is said to be at 2% premium. From this calculate the par of exchange.
 6. How large a bill of exchange on Paris can be bought for \$1,500 currency, exchange being at this rate of \$1 for 5.25 francs, and gold being at a premium of $8\frac{1}{2}\%$?

MISCELLANEOUS EXERCISES.

XXVI.—ANALYSIS AND CANCELLATION.

1. If 6 iron bars 4 ft long, 3 in. broad and 3 in. thick, weigh 144 lbs., how much will 13 weigh, each 6 $\frac{1}{2}$ ft. long, 4 in. broad and 3 in. thick?

3. If the property of a city is valued at \$1,000,000, and a man who owns property assessed at \$5,000 pays \$100 in taxes, what is the total tax levied?
4. If a ton of coal occupies 40 cu. ft.; what will it cost to fill a bin 12 ft. long, 6 ft. wide and 5 ft. deep, with coal at \$5.25 a ton?
5. If \$30.25 pay for $3\frac{1}{2}$ tons of coal, what will $\frac{1}{4}$ of a ton cost?
6. If $\frac{1}{2}$ of $\frac{3}{4}$ of $3\frac{1}{2}$ yds. of cloth cost $\frac{1}{4}$ of $\frac{3}{4}$ of \$4 $\frac{1}{2}$, what fraction of a dollar will $\frac{1}{4}$ of $\frac{1}{2}$ of $\frac{3}{4}$ of a yard cost?
7. If 8 men can saw 240 cords of wood in 36 days, each 12 hours long, how many men can saw 90 cords in 6 days, each 9 hours long?
8. If 600 bricks, 8 in. long and 2 in. wide, are required for a walk 100 ft. long and 4 ft. wide, how many bricks are required for a walk 20 ft. long and 6 ft. wide?
9. The pound Avoir. contains 7,000 gra. Troy; and 960 sovereigns weigh 20 lbs. Troy; find the number of sovereigns coined from an ounce Avoir.
10. A block of stone $5' \times 3' 9" \times 2' 6"$ weighs 7,500 lbs. (112 = cwt.); what is the weight of a block of the same stone $12' 6" \times 6' 6" \times 8' 3"$?
11. Reduce to simplest form

$$\frac{15 \times 18 \times 21 \times 24 \times 27 \times 30 \times 33}{16 \times 19 \times 22 \times 25 \times 28 \times 31 \times 34}$$

12. If $16\frac{1}{2}$ cords of wood last as long as $11\frac{1}{2}$ tons of coal, how many tons of coal will last as long as $22\frac{1}{2}$ cords of wood?

Find the value of:

$$12. \frac{\frac{1}{2}}{1\frac{1}{2}} \times \frac{\frac{1}{4}}{1\frac{1}{2}} \times \frac{25}{16} \times \frac{21}{35} \times \frac{1}{1\frac{1}{2}}$$

$$13. \frac{27}{37\frac{1}{2}} \times \frac{87\frac{1}{2}}{93\frac{1}{2}} \times \frac{2\frac{1}{2}}{2\frac{1}{2}} \times \frac{51\frac{1}{2}}{128} \times \frac{7\frac{1}{2}}{15}$$

17. The base of a pyramid is a square, each side of which is 10 ft. Find the volume, the slant height being 13 ft.
18. The base of a pyramid is a square, each side of which is 10 ft. Find the volume, the slant height being 13 ft.
19. The base of a pyramid is a rectangle which is 30 ft. by 20 ft. Find the volume, each of the edges which meet at the vertex being 30 ft.
20. The base of a pyramid is a square, each side of which is 10 ft. The length of the straight line drawn from the vertex to the middle point of any side of the base is 12 ft. Find the volume.

XLIII.—THE SPHERE.

Form.—Surface = $4\pi r^2$; volume = $\frac{4}{3}\pi r^3$.

A.

In the following $r = 3$.

Find the surface area of a sphere

1. In which $r = 3$ ft.
2. In which $r = 10$ ft.
3. In which $r = 5$ ft. 6 in.
4. In which $r = 11$ feet.

Find the volume of a sphere

5. In which $r = 3$ ft.
6. In which $r = 10$ ft.
7. In which $r = 5$ ft. 6 in.
8. In which $r = 11$ feet.
9. In which $r = 12$ ft.
10. In which $r = 13$ ft.
11. In which $r = 14$ ft.
12. In which $r = 15$ ft.

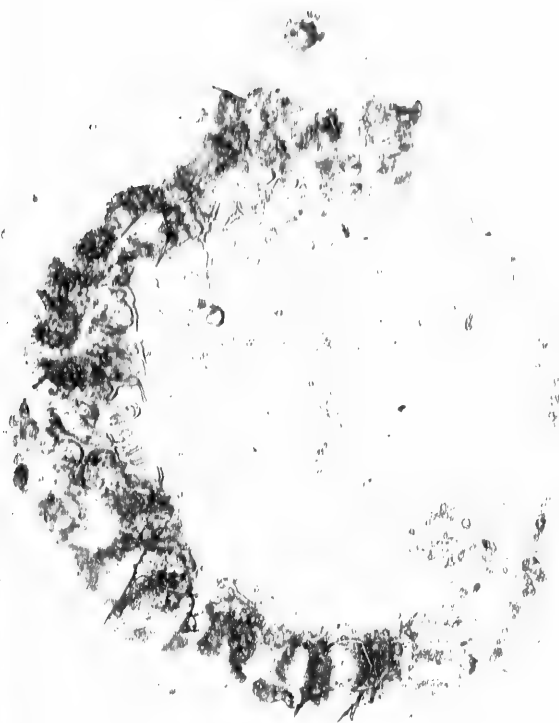
B.

Find the surface area and volume of a sphere in which the radius is 11 ft.

1. The volume of a sphere is 3600 cu. in. Find the radius.
2. The volume of a sphere is equal to half the volume of a cylinder whose diameter is the same as the sphere's diameter and its height is 8 feet. Find the radius of the sphere.
3. A spherical shell is 3 in. in diameter and 1/2 in. thick. Find the volume of the shell.
4. The inner radius of a spherical shell is 10 in. and the thickness of the shell is 1/2 in. Find the volume of the shell.
5. Find the weight of a steel 3/4 in. thick whose diameter is 17 1/2 in., if it weighs 480 lb/cu. in.
6. A spherical shell, internal diameter 14 inches, was water. It was then filled with a liquid of weight 60 lb/cu. in. Find the weight of the water in the cylinder.
7. The diameter of the head of a cone is 3 in. and its volume is equal to that of a spherical shell whose thickness is equal to its external diameter and whose radius is 1 in. Find the height of the cone.
8. A sphere whose diameter is 3 feet, is submerged in the water of a circular cistern of 3 feet diameter. How deep is the water in the cistern when the sphere is submerged?
9. Find how long it will take to fill a spherical tank of 10 feet in diameter from a pipe which supplies it with 6.25 cu. ft. of water per hour. $\pi = 3.14$.

EXERCISES - CHAPTER 10 - SURFACES

1. Find the surface area of a sphere whose radius is 3 in.
2. Find the surface area of a sphere whose diameter is 4 in.
3. Find the surface area of a sphere whose circumference is 10 in.
4. Find the surface area of a sphere whose volume is 3600 cu. in.
5. Find the surface area of a sphere whose weight is 480 lb., if it weighs 480 lb/cu. in.
6. Find the surface area of a sphere whose weight is 480 lb., if it weighs 480 lb/cu. in.
7. Find the surface area of a sphere whose weight is 480 lb., if it weighs 480 lb/cu. in.
8. Find the surface area of a sphere whose weight is 480 lb., if it weighs 480 lb/cu. in.
9. Find the surface area of a sphere whose weight is 480 lb., if it weighs 480 lb/cu. in.
10. Find the surface area of a sphere whose weight is 480 lb., if it weighs 480 lb/cu. in.



$$\begin{array}{cccc}
 \frac{1}{2} \text{ of } \frac{1}{3} & \frac{1}{3} \text{ of } \frac{1}{2} & \frac{1}{4} \text{ of } \frac{1}{5} & \frac{1}{5} \text{ of } \frac{1}{4} \\
 \frac{1}{12} \text{ of } \frac{1}{3} & \frac{1}{12} \text{ of } \frac{1}{3} & \frac{1}{20} \text{ of } \frac{1}{5} & \frac{1}{20} \text{ of } \frac{1}{5} \\
 \frac{1}{24} \text{ of } \frac{1}{12} & \frac{1}{24} \text{ of } \frac{1}{12} & \frac{1}{40} \text{ of } \frac{1}{20} & \frac{1}{40} \text{ of } \frac{1}{20} \\
 \frac{1}{48} \text{ of } \frac{1}{24} & \frac{1}{48} \text{ of } \frac{1}{24} & \frac{1}{96} \text{ of } \frac{1}{48} & \frac{1}{96} \text{ of } \frac{1}{48}
 \end{array}$$

XXVII.—RATIO AND PROPORTION.

1. Divide 36 in the proportion of 2 to 3.
2. Divide \$80 among A, B and C in the proportion of 4, 5 and 7.
3. A can run 6 yds. while B can run 7. How many yards start can A give B in a half-mile race, so that neither will win?
4. A can run 90 yards while B runs 100, and B can run 90 yds. while C runs 100. How much does C beat A in a 100 yard race?
5. Divide \$234 among A, B and C, in the proportion of $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$.
6. A and B entered into partnership, their capitals being in the ratio of 7 to 3. After 3 months A withdrew part of his capital, so that the ratio was 2 to 3. At the end of the year A's share of the gain was \$1,200; what was B's gain?
7. A farm is divided into two parts, whose areas are as 9 to 13; the area of the larger part exceeds that of the smaller by 18 $\frac{1}{2}$ acres. Find the number of acres in the farm.
8. Gunpowder is composed of nitre, charcoal and sulphur, in the proportion of 33, 1, 5; how many lbs. of sulphur are in 135 pounds of powder?
9. A vessel contains 3 parts brandy and 2 parts water. How much of the mixture must be drawn off and be replaced by water that the ratio may be reversed?
10. Divide \$171.50 into parts proportional to 4, 5, 6.
11. A debt of \$28 is paid in 25 bills, 20 bills and 25 bills, the number of each denomination being proportional to 4, 7 and 10; how many were there of each?

LXVIII.—SHARING.

1. A bankrupt owes four creditors as follows: A \$2,500; B \$3,500; C \$4,500; and D \$4,500. He possesses only \$15,000; what does each creditor receive?
2. Divide \$100 among three boys, A, B and C, so that B's share may be half as much again as A's, and C's a third as much again as A's and B's together.
3. Divide \$625 among two boys that the simple interest on one share for 3 years at $4\frac{1}{2}\%$ will be equal to the simple interest on the other share for $2\frac{1}{2}$ years at 5% .
4. A, B and C caught a certain number of fish; when A's fish and B's are put together they make 110; B's and C's 130; A's and C's 120. If the fish be shared equally among them, what is the share of each?
5. A farmer shared his farm among his three sons; to the youngest he gave 80 acres, to the eldest $\frac{1}{2}$ of the whole, and to the second $\frac{1}{2}$ as much as to both the others. How many acres did the farm contain?
6. The sum of \$1,416 is to be divided among 15 men, 25 women and 30 children, in such a manner that a man and a child shall together receive as much as two women, and all the women together shall receive \$450. Find the amount received by each man, woman and child respectively.
7. If 15 men, 10 women, and 25 boys earn \$15,000.00 in a year (300 working days); and if a woman earns $\frac{1}{2}$ of what a man earns, and a boy $\frac{1}{3}$ of what a woman earns, what is the daily earning of each?
8. A, B and C do a piece of work and are paid \$75 for it. The money is divided according to their shares, and the time each worked; A's efficiency is to B's as 2 to 3, and B's to C's as 4 to 5; A worked 6 days, B 7 days, and C 8 days. How should the money be divided?
9. What does each man, woman and child get when

- \$78.22 is divided among 6 men, 3 women and 10 children, so that 2 men may get as much as 3 women, and women as much as 3 children?
10. A man divided \$17,940 among his 3 sons, whose ages are 16, 18 and 26 years, in proportion to their ages; three years afterwards he similarly divided an equal sum, and again after 3 years more; how much did each son receive altogether?

XXIX. WORKING PROBLEMS.

1. A can chop 4 cords of wood in 3 days, B can chop as much in 3 days as A in 4 days. How long would both together be in chopping 28 cords?
2. A did $\frac{1}{2}$ of a piece of work, B did $\frac{1}{3}$ of the remainder, C did $\frac{1}{4}$ of what was left undone by B, and D finished the work. How much should D get for his work if A receives \$8.40 for his?
3. Three men, A, B and C, working together can do a piece of work in 10 days. They undertake the job and work on it for 4 days; C then quits, and A and B finish the work in 10 days. If A could have done the whole work by himself in 30 days, in what time could each of the others have done it?
4. A and B can do a piece of work in 8 days when the days are 12 hours long; A by himself could do the work in 12 days of 16 hours each. In how many days of 14 hours long could B do the work?
5. If 8 men and 5 boys mow $7\frac{1}{2}$ acres of grass in 3 days, and 6 men and 7 boys in another field mow 25 acres in 12 days, how long will it take these 14 men and 12 boys to mow 12 acres?
6. If 2 men in 10 weeks of 5 working days each, working 11 hours a day, dig 11 cellars, each 20 ft. long, 16 ft. wide and 5 feet deep; how many men will be required to dig 16 cellars, each 24 ft. square and 4 ft. deep, in 12 weeks of 6 days each, working 9 hours per day?

7. A does $\frac{1}{4}$ of a piece of work in 16 days and then B joins him. They work together for 2 days, when B leaves and A finishes the work in $3\frac{1}{2}$ days more. How long would it take B to do the whole work?
8. A can do a piece of work in 12 days, B in 15 and C in 16. They all begin together at the work but only C continues till the work is finished, A leaving in $2\frac{1}{2}$ days, and B $1\frac{1}{2}$ days after A. In what time is the work done?
9. A and B together can do a piece of work in $5\frac{1}{2}$ days. A and C together can do it in 6 $\frac{1}{2}$ days and B and C together in $7\frac{1}{2}$ days. How long would it take A, B and C together to do the work?
10. A, B and C can do a work in $3\frac{1}{2}$ days, A, B and D together in 3 $\frac{1}{2}$ days, A, C and D together in $3\frac{1}{2}$ days, and B, C and D together in 4 days. How long would it take all four together to do the work?

XXX.—ALLIGATION AND MIXTURES.

1. A grocer has teas worth 30, 40, 80 and $83\frac{1}{2}$ cents per lb.; he wishes to make a mixture of 80 lbs., so that he may sell at 70c. per lb., and make 20% profit. How much of each kind must he use?
2. A mixture of 7 lbs. black tea and 8 lbs. green are worth \$5.28, while a mixture of 12 lbs. black and 3 lbs. green are worth \$5.73. Find the value per lb. of each.
3. 6 geese and 5 turkeys are worth \$5.95, and 7 geese and 8 turkeys are worth \$8.35. Find the price of each.
4. A mixture of 60 lbs of two teas cost \$24.60; the cheaper is worth 35c. per lb. and the dearer 45c. Find the number of lbs. of each in the mixture.
5. 11 horses and 8 cows are worth \$1,096, and 7 horses and 5 cows are worth \$695. How much is one of each worth?
6. A grocer mixed two kinds of wine, worth respectively

6. \$2.40 and \$3.20 per gal., in such a proportion that by selling the mixture at \$2.80 per gal. he made a profit of 10%. Find the proportion in which the wines were mixed.
7. In what proportion must two kinds of coffee, which cost 50c. and 65c. per lb., respectively, be mixed, so that when sold at 60c. per lb., there may be a gain of 11%?
8. When wheat is worth 80c. per bu., 17 bushels of a mixture of wheat and oats are worth \$12.55; but if the proportions in the mixture were interchanged, its value would be \$8.70. Find the price of oats per bushel.
9. A cask contains 7 parts of brandy and 5 parts of water; $\frac{1}{3}$ of the mixture is drawn off and the cask filled with water; what is the strength of the mixture then?
10. A wine merchant mixes 8 gal. of wine worth \$1.15 a gal., 12 gal. worth \$1.20 a gal., and 15 gal. worth \$1.40 a gal., with 20 gal. of water, and sells the mixture at \$1 a gal. Find his gain per cent.
11. A mixture of 50 gal. of alcohol and water contains 60% alcohol. (a) How much water must be added to reduce the strength to 62%? (b) How much alcohol must be added to increase its strength to 67%?

EXXI — INVOLVING SUM AND DIFFERENCE.

1. The sum of two numbers is 5045, and their difference 1328; find the numbers.
2. The sum of two numbers is 8045; their difference 1380; find the product of the numbers.
3. The sum of two numbers is 7631 and their difference 1267. Find the difference of their squares.
4. There are 309 pupils in a school, and 17 more girls than boys. How many are there of each?
5. At an election, A and B were the only candidates.

The total number of votes polled was 414. A was elected by 172. How many voted for B?

6. The total number of entering candidates is 240. A is an election in which B and C were the nominees. B was elected by a majority of 92. It was found that the number who voted exceeded the number who didn't vote by 242. How many votes did the defeated candidate receive?
7. Divide \$2,743.95 between John and Thomas so that John may have \$127.45 more than Thomas.
8. The sum of two numbers is 94, and their difference is 48. Four times the larger is how many times the smaller?
9. It takes 6046 rails for a 6-railed straight fence around a farm, the rails being 11 ft. long. If the length of the farm is 120 rods more than its breadth, how many acres does the farm contain?
10. Two men, by working together, can perform a piece of work in 18 days. If the job is worth \$900, and one man works five days less than the other, how should the money be divided?
11. The sum of two numbers is 4975; their common factor is 17; the difference between the other two factors is 21. What are the numbers?
12. A man rows down stream a distance of 24 miles in 3 hours, and back again in 4½ hours. Find his rate of rowing in still water.
13. A man rowed down stream 22½ miles in 3 hours, but it took him 9 hours to row up. Find the rate of the stream.
14. A man can row 6 miles an hour in still water. Compare his rate of rowing down with his rate of rowing up a stream which flows at the rate of 2½ miles an hour.
15. A man can row a certain distance down a stream in 20 minutes, and up again in 40 minutes. If the stream flows at ½ mile an hour, find the distance.

16. Two trains respectively 150 yds. and 100 yds. long, going in opposite directions, pass each other in 3 seconds; when moving in the same direction the first passes the other in 45 seconds. Find their rates in miles per hour.
17. Two trains, moving on parallel tracks, are respectively 132 yds. and 92 yds. long, and pass each other in $2\frac{1}{2}$ seconds. When moving in the same direction the one passes the other in 47 seconds. Find their rates per hour.
18. The duty on imported axes is \$1.50 per dozen, and 8 $\frac{1}{2}$ % ad valorem. The whole duty paid on a lot of axes was \$45, the specific duty being \$19.80 more than the ad valorem. Find the number of axes imported.

XXII.—SOLAR AND STANDARD TIMES.

1. How are solar and standard times reckoned?
2. Where is the zero zone? How wide is it? What meridian lines bound the east and west sides?
3. Name the centre meridians of the time zones between 52 $\frac{1}{2}^{\circ}$ W. and 142 $\frac{1}{2}^{\circ}$ W. longitude. By what local names are some of these zones known?
4. When it is 2 p.m. at Greenwich, find standard times at 75 $^{\circ}$ W.; 90 $^{\circ}$ W.; 104 $^{\circ}$ W.; 106 $^{\circ}$ W.; 118 $^{\circ}$ W.
5. When it is 11.15 a.m. at New York, 73 $\frac{1}{2}^{\circ}$ W., find the standard times at Washington, 77 $^{\circ}$ W.; Toronto, 79 $^{\circ}$ W.; San Francisco, 122 $\frac{1}{2}^{\circ}$ W.; Chicago, 88 $^{\circ}$ W.; Halifax, 63 $\frac{1}{2}^{\circ}$ W.; Glasgow, 4 $\frac{1}{2}^{\circ}$ W.; Limerick, 9 $^{\circ}$ W.; Hamburg 10 $^{\circ}$ E.
6. When it is 7.30 a.m. solar time at Winnipeg, 97 $^{\circ}$ 15' W., find the solar times at places: 44 $^{\circ}$ W.; 120 $^{\circ}$ 30' W.; 55 $^{\circ}$ 45' W.; 80 $^{\circ}$ E.; 4 $^{\circ}$ 30' E.; 12 $^{\circ}$ 15' E.
7. When it is 7.15 a.m. true time at Rio Janeiro 45 $^{\circ}$ W., find the longitude of places whose true times are 5.30 a.m.; 7.45 a.m.; 6 a.m.; 10 a.m.; 11.30 a.m.; 2.45 p.m.; 10.03 a.m.

9. What is the longitude at Winnipeg $97^{\circ}15'W.$ at 10.15 a.m.?
9. What is the true time at Boston $71^{\circ}10'W.$ at 2.45 a.m.?
10. What is the difference between the true and the standard time at Goderich $81^{\circ}40'W.$?
11. A vessel left Liverpool $5^{\circ}W.$ on Monday, June 1st at 3.15 a.m., and reached New York $73\frac{1}{2}^{\circ}W.$, in 6 days, 10 hrs., 40 min. When did the vessel arrive?
12. A vessel left Capetown $18^{\circ}E.$ on Monday, July 6th, at 3.30 a.m., and arrived at Montreal $73^{\circ}W.$ in 12 days, 8 hours. Find the time of arrival?
13. Find the longitude of the Falkland Islands, if it is 6 a.m. there, when it is 1 p.m. at Ras el Had, the longitude of which is $60^{\circ}E.$
14. Calcutta is $86^{\circ}E.$ longitude, and Rome $12^{\circ}30'E.$ What is the time at Calcutta when it is 9.18 a.m. at Rome?
15. Quebec is $71^{\circ}18'W.$ and Vienna $16^{\circ}24'E.$ longitude. When it is 2 p.m. at Vienna, find the standard time at Quebec.
16. At 2.20 p.m. a telegram is sent from St. Petersburg long. $30^{\circ}E.$ to St. John, New Brunswick, long. $66^{\circ}W.$ Allowing 75 minutes for delays and transmission, when will it be received at St. John?

XXIII—CLOCK PROBLEMS.

1. At what time are the hands of a clock together? Between 3 and 4? Bet. 6 and 7? Bet. 8 and 9?
2. At what times are the hands of a clock at right angles: Between 4 and 5? Between 7 and 8?
3. At what time are the hands exactly opposite? Between 2 and 3? Between 4 and 5?
4. At what times are the hands 15 minutes apart? Between 4 and 5? Between 6 and 7?

9. When will the minute hand be midway between the hour hand, and the figure IV. after 4 o'clock? And the figure III. after 5 o'clock? And the figure II. after 6 o'clock?
10. At what time between 4 and 5 o'clock are the hands of a clock (1) coincident? (2) 2 spaces apart?
11. At what two times between 5 and 6 are the hands equally distant from the figure III.?
12. When first after 7 o'clock will the hour hand be midway between the figure V. and the minute hand?
13. What is the time when $\frac{1}{2}$ of the time past noon is $\frac{1}{3}$ of the time till midnight?
14. The hands of a clock move irregularly, the hour hand moving 5% too fast, and the minute hand 10% too slow. In 15 minutes (true time) they will be together. How many minutes measured on the face of a clock are they apart now?
15. The three hands of a clock rotate on the same axis. When first after 3 will the minute hand be half-way between the second hand and the hour hand?

XXIV.—ON ALGEBRAIC FORMULÆ.

1. The square of 2345 is 5496025. Find the square of 2347.
2. The square of 4567 is 20857489. Find the square of 4563.
3. Find the sum of the squares of 9998 and 10002.
4. Find the product (1) of 1003 and 997; (2) 9915 and 9985.
5. Find the continued product of (a) 3, 11, 101 and 10001; (b) 10081, 100, 10 and 7.
6. Find the value of $(1 + 4 + 4^2 + 4^3 + 4^4 + 4^5)(4 - 1)$; also find the value of $(6^4 - 6^3 + 6^2 - 6 + 1)(6 + 1)$.
7. Simplify $(275)^2 - (125)^2$.

$$(275)^2 - (125)^2 = (275 + 125)(275 - 125)$$

8. Simplify

$$\frac{(176)^2 + (136)^2}{(176)^2 - (136)^2} \cdot \frac{(136)^2 + (176)^2}{(176)^2 - (136)^2}$$

9. Find the value of $(3)^2 + (2)^2 + (\frac{1}{3})^2 + 2(3)(2) + 2(3)(\frac{1}{3}) + 2(2)(\frac{1}{3})$

10. Find the value of $2\frac{1}{2} + 1\frac{1}{2} + 1\frac{1}{2} + 1\frac{1}{2} + 1\frac{1}{2} + 1\frac{1}{2} + 1\frac{1}{2}$

11. Simplify $(\frac{1}{2})^2 + 2(\frac{1}{2})^2(\frac{1}{2}) + 2(\frac{1}{2})(\frac{1}{2})^2 + (\frac{1}{2})^2$

12. Simplify $(\frac{1}{2})^2 - 2(\frac{1}{2})^2(\frac{1}{2}) + 2(\frac{1}{2})(\frac{1}{2}) - (\frac{1}{2})^2$

13. Find the value of $\frac{1}{2} + \frac{1}{3} + \frac{1}{6} + \frac{1}{6}$; also of $\frac{1}{12} - \frac{1}{12} + \frac{1}{12} - \frac{1}{12}$

14. Simplify $\frac{(\frac{1}{2})^2 - (\frac{1}{3})^2}{(\frac{1}{2})^2 + (\frac{1}{3})^2 + (\frac{1}{6})^2 + (\frac{1}{6})^2 + (\frac{1}{6})^2 + (\frac{1}{6})^2 + (\frac{1}{6})^2 + (\frac{1}{6})^2}$

15. Simplify $(\frac{1}{2} - \frac{1}{3}) \times (\frac{1}{12} + \frac{1}{12} + \frac{1}{12} + \frac{1}{12} + \frac{1}{12} + \frac{1}{12})$

16. Simplify $(\frac{1}{2} + \frac{1}{3}) \times (\frac{1}{12} - \frac{1}{12} + \frac{1}{12} - \frac{1}{12} + \frac{1}{12} - \frac{1}{12} + \frac{1}{12})$

17. Simplify $(\frac{1}{2})^2 + (\frac{1}{2} + \frac{1}{3} + \frac{1}{6})(\frac{1}{2})^2 + (\frac{1}{2} + \frac{1}{3} + \frac{1}{6})(\frac{1}{2}) + \frac{1}{2} + \frac{1}{3} + \frac{1}{6}$

18. Find the value of (a) $(\frac{1}{2} + \frac{1}{3})^2 - (\frac{1}{2} - \frac{1}{3})^2$; (b) $(\frac{1}{12} + \frac{1}{12} - \frac{1}{12} - \frac{1}{12})^2$

Reduce to their simplest form:

$$\text{19. } \frac{3+4+5+16+33+64+125}{3+6+12+24+48+96+192}$$

$$\text{20. } \frac{3+6+18+72+432+3024+24192}{6+8+24+96+576+4032+32256}$$

XXXV.--SQUARE ROOT

Find the square root of:

1. 127448

2. 242004

3. 2420025

4. 1076

5. 404025

6. 5 to five decimal places

7. 1.1 to three places of decimals

9. 34 to four dec. places.
10. 34 to four dec. places.
11. 34 to six dec. places.
12. 34 to five dec. places.
13. 13 to five places of decimals.
14. 34 to five places.
15. $.047619 + 1.190476$.
16. Find within one inch the side of a square whose area is 5 acres.
17. A square field, containing 16 acres 401 sq. yds., has a walk around it outside, 12 ft. in width. Find the area of the walk in yards.
18. A rectangular field, whose length is three times its breadth, contains 6 acres 900 yds.; find its breadth.
19. The L.C.M. of two numbers is 100,798; their G.C.M. is 17; their difference 1,224. Find the numbers.
20. The side of a square field is 48 rods; find the length of the side of a square field containing $2\frac{1}{2}$ times as much land.
21. The product of the sum of two numbers by their difference is 27,436,668. The smaller number is 2,061. Find the larger.

XXXVI.—CUBE ROOT.

Find the cube root of :

1. 1953125.
2. 499173632007.
3. 62715723317.
4. 1070800625.
5. 308502322.
6. 170607.089283.
7. 492.780025.
8. 430052.
9. 807864103.

10. Find the area of a rectangle.

11. Find the area of a square.

12. Find the area of a rectangle, if the length is $\sqrt{15}$ and the width is $\sqrt{3}$.

MENSURATION.

XXVII.—RECTANGLES.

1. A rectangle measures 40 ft. by 30 ft.; find the area of a square which has the same perimeter.
2. A half-acre lot is 10 rods long. A 5-strand wire fence is put around it. How much wire at 5c. per lb. will be required if 2 yards cost 6 cents?
3. What is the surface of a board 19 in. wide at one end, and 24 in. wide at the other, and 10 ft. long?
4. It is cost \$12.20 for paper for a room 25' 3" long, 19' 6" wide, and 11' high, when the paper is $\frac{1}{2}$ yd. wide, find the cost of the paper per linear yard. (No allowance for doors and windows).
5. What is the cost of boards, at \$1 for 50 sq. feet, to make a closed box 7' 10" long, 3' 8" wide, and 2' 6" high (outside dimensions), the boards being 1 inch thick?
6. Find the cost of gravelling, at 12½c. per square yard, a path 2 yards wide, running around the inside of a square field containing 40 acres.
7. A country in the form of a rectangle, 300 miles long by 200 miles broad, supports a population of 20,000,000; find the average number of acres required to support one person.
8. It costs \$35.25 to carpet a room 22 ft. 6 in. long, with carpet 27 in. wide, at \$1.75 per yard; find the width of the room.
9. A railway company pays \$34.75 per acre for a portion of road 100 miles long and 34½ ft. wide. Find the value of the road.

Find the cost of painting the walls and ceiling of a room 12 ft. long, 10 ft. wide, and 8 ft. high, at the rate of 15¢ per sq. yd. (The allowance for openings is 100 sq. ft. for the door and 200 sq. ft. for the windows.) Find the cost of carpeting such a room with carpet 50¢ per sq. yd. and sewing 25¢ per yd.

EXERCISES

1. How many feet of lumber will be required to build a building 60 ft. long, 40 ft. wide, 20 ft. high, with each side of the roof 24 ft., allowing 100 sq. ft. for the gables, and making no deduction for doors and windows?
2. What the cost of the material required to fence a mile of railway (both sides), posts placed 10 ft. apart, at 6-inch base 1 inch thick, a 2-in. rail, at 10¢ per lb., and 4 strands of wire. The posts are 10¢ per lb., the lumber \$14 a thousand, and the wire 1¢ per pound. (A pound of wire stretches one mile.)
3. A cord of containing $\frac{1}{4}$ of an acre is 4 rods long. Find the total cost of the material for a picket fence around 100 acres, 5 ft. wide and 4 rods long, 2 ft. apart, two stringers 2" x 4", and an inch board. Find the number being worth \$15 per 1000 ft. 3" x 4" fence posts to centre at 10 ft. each side.
4. The lengths of the sides of a rectangular piece of land are 3 to 4, and the area is 120 acres. Find the length of the sides in inches.
5. A gentleman bought 4 sections of land, each of 100 acres, at \$20 per acre. Find the cost.
6. What the cost of painting a square lot 100 ft. on a side, the means of 4 wire fences, 10 ft. apart, 10¢ per rod, 10¢ per rod, 10¢ per rod, 10¢ per rod, and the work 10¢ per rod.
7. A man having a lot of 10 rods, and a fence 10 rods long, is paid for 10¢ per rod.
8. The area of each of the four sides of a square is 100 sq. ft. Find the area of each of the four sides.

10. A carpet is 25 ft. wide and 30 ft. long. If the carpet is covered with a material that costs \$2.50 per sq. yd., find the cost of the carpet.
11. The length of a rectangle is 75 ft. If the width was increased by 5 ft., the area of the rectangle would be 325 sq. yards. Find the width of the original rectangle.
12. A room whose height is 12 ft. and length is 15 ft. is to be carpeted. If the carpet costs \$1.50 per sq. yd., find the cost of the carpet.
13. A rectangular plot of ground is 60 ft. long and 30 ft. wide. A path is made surrounding the plot on the outside and two others intersecting at right angles in the middle of the plot. If these paths are 5 ft. wide, find the area of the plot.
14. A rectangular plot of ground is 60 ft. long and 30 ft. wide. A path is made surrounding the plot on the outside and two others intersecting at right angles in the middle of the plot. If these paths are 5 ft. wide, find the area of the plot.
15. A rectangular plot of ground is 60 ft. long and 30 ft. wide. A path is made surrounding the plot on the outside and two others intersecting at right angles in the middle of the plot. If these paths are 5 ft. wide, find the area of the plot.

EXERCISES—TRIANGLES

1. Find the product of the base and height of a triangle whose base is 10 ft. and height is 12 ft.
2. Find the area of a triangle whose base is 10 ft. and height is 12 ft.



Find the area of the following triangles:

1. Base 25 ft., height 4 ft.
2. Base 45 ft., height 35 ft.
3. Base 7 yds. 1 ft., height 4 yds. 3 ft.
4. Base 9 yds. 2 ft. 6 in., height 7 yds. 1 ft. 5 in.

Find the areas of triangles whose sides are

5. 35 in., 47 in., 75 in.
6. 30 ft., 45 ft., 112 ft.
7. 24 in., 32 in., 30 in.
8. 34 yds., 35 yds., 36 yds.
9. 312, 444 and 455.
10. 17, 68 and 75.

In right angled triangles whose

11. Base=6 ft., perpendicular=6 ft., find hypotenuse.
12. Base=40 ft., perpendicular=9 ft., find hypotenuse.
13. Base=15 ft., perpendicular=112 ft., find hypotenuse.
14. Perpendicular=13 ft., hypotenuse=35 ft., find base.
15. Base=15 yds., hypotenuse=17 yds., find perpendicular.
16. Hypotenuse=9.73 ft., perpendicular=8.6 ft., find the base.
17. The sides of a triangle are 35, 50 and 55 ft. respectively; find its area.
18. The sides of a triangular field are 315 yds., 380 yds. and 675 yds.; the field is rented at \$11 an acre, find the rent.

B.

1. A footpath goes up the side and then along the end of a rectangular field 439 yards by 300 yards. What distance will be saved by cutting right across in the direction of the diagonal?
2. The sides of a triangle are 13, 14 and 15 ft., find the perpendicular length of the 14 ft. side from the angle opposite; also find the area of each of the two parts into which the triangle is divided.
3. Find the length of the diagonal of a quad 12, 13, 14, 15.

1. A rectangular field contains 64 acres. The sides are 5 rods and 8 rods per acre. How long are the sides of the field?
2. A square field containing $67\frac{1}{2}$ acres has a diagonal road across it. What is the length of the path in miles?
3. The base of an isosceles triangle is 50 ft., and each of the two equal sides is $15\frac{1}{2}$ ft. What is the altitude of the triangle?
4. A man can walk the length of the diagonal of a rectangular field containing 6 acres, whose sides are 5 to 12, in $3\frac{1}{4}$ minutes; find his rate of walking in miles per hour.
5. Find the perimeter of a right-angled triangle whose area is 270 sq. ft., and the base 15 feet.
6. The sides of a triangle are 40, 45 and 50 feet, respectively. Find the length of the perpendicular from the vertex to the side 45 feet.
7. The diagonals of a rhombus are 8 in. and 10 in., respectively. Find the area.
8. The top of a ladder reaches to the top of a wall when its foot is at a distance of 10 ft. from the bottom of the wall, but if the foot of the ladder be drawn 4 ft. farther from the wall, the top of the ladder will reach a point 3 ft. below the top of the wall. Find the length of the ladder.
9. There is a garden-plot in the form of a trapezoid, whose two parallel sides are 40 yds. and 50 yds. respectively; the other sides being, respectively, 30 yds. and 24 yds. Show that the perpendicular distance between the parallel sides is $4\sqrt{11}$.

XXXIX. RIGHT PARALLELOPIPED AND PRISM.

1. Find the number of cubic ft. and in. in a cube whose length is 2 ft. 6 in.

4. A log of round 42 in. in length extends from the surface of a pond of 54 acres. Find the value of the log if it weighs 10 cubic feet per cubic yard.
5. Find the weight of a stack of bricks 10 ft. long, 3 ft. wide, and 3 ft. thick, assuming a brick to be 1 in. long, 4 in. wide, and 3 in. thick, and to weigh 10 pounds.
6. A cistern is 18 ft. 6 in. long, and 6 ft. 9 in. wide. Find through how many inches the surface will sink if 100 gallons of water are drawn off.
7. Find to the nearest gallon the volume of a cask whose length is 30.5 in., by 120.5 in., by 50 in.
8. A square plot of ground that contains $\frac{1}{4}$ of an acre is planted with cypress (4 ft. long) to the nearest height of 12 ft. What is the board width at 12 ft. a cord?
9. Find the number of cubic ft. in a barn log 12 ft. square at one end, and 9 ft. square at the other, the length being 37 ft.
10. If I, 188, then describe a square beam whose side is 1.88 yds., and which is 30 yds. long. In 1 year how many men will be required to remove a square beam whose side is 2.088 yds., and which is 30 yds. long, in 12 months.
11. When the temperature of a cube of steel is raised from 32°F. to 32°C. , each dimension is increased .0001 in. Find the percentage of increase in the bulk.
12. A rectangular solid 4 ft. long, 3 ft. broad, and 2 ft. thick is measured 11 in. in thickness. By how much is the breadth to be diminished, so that the solid may be the same bulk as before?
13. A rectangular solid is 6 ft. long, 4 ft. broad, and 2 ft. thick. The material is made of such a sort that the weight of the material is equal to half a ton of the same material. Find the weight of each brick 6 ft. 3 in.

XL.—ON THE CIRCLE

A.

Notes: (1) $c = \pi d$. (2) Area = $\frac{1}{2} d \times \frac{1}{2} d$. (3) Area = πr^2 .

In the following examples $\pi = 3\frac{1}{2}$.

1. Find the circumference, having given (1) Diameter = 4 ft. (2) Diameter = $6\frac{1}{2}$ yds. (3) Diameter = 3 yds. 2 ft. 4 in. (4) Radius = 10 ft. (5) Radius = $2\frac{1}{2}$ yds. (6) Radius = 2 yds. 1 ft. 0 in.
2. Find the area of the circle whose—(7) Radius = 7 ft. (8) Radius = 6 yds. 2 ft. (9) Radius = 6 ft. 9 in. (10) Diameter = $6\frac{1}{2}$ in. (11) Diameter = 6 ft. 5 in. (12) Diameter = 3 yds. 1 ft. 7 in. (13) Circumference = 21 feet. (14) Circumference = 75 feet. (15) Circumference = 11 ft. 8 in.
3. What will the wire cost for a fence five wires high around a circular fish-pond, 60 ft. in diameter, 100 yds. of wire costing \$1.25?
4. Find the length of the radius of a wheel which makes 4,000 revolutions in going 13 miles.
5. The radius of a carriage wheel is 15 in.; how many turns will the wheel make in travelling one mile?
6. Find the length of the arc which subtends an angle of 36° at the centre of a circle whose radius is 20 in.
7. Over what fraction of an acre can a cow, which is tethered with a rope 28 ft. long, graze?

B.

In the following examples, $\pi = 3.1416$.

1. Find the difference between the area of a rectangle 27 ft. by 22 ft., and a circle whose circumference is the same as the perimeter of the rectangle.
2. The radius of a circle is 6 ft.; find the radius of another circle of twice the area.

2. The diameter of a circle is 24 in.; find the area of the segment of the circle cut off.
3. A road runs around a circular pond; the outer circumference is 220 ft., and the inner 210 ft. Find the breadth and area of the road.
4. A road runs around a circular pond; the outer circumference is 440 yards, and the width of the road is 20 yards. Find the area of the road.
5. The area of a circle is equal to that of a rectangle which is 512 ft. by 200 feet; find the circumference of the circle.
6. Find the side of a square which is equal to the area of a circle of 160 ft. diameter.
7. Find the perimeter of a semicircle whose area is 625 sq. feet.
8. A circle is 11 ft. in circumference; find the area of a square inscribed in it.
9. A circle is 78.54 inches in circumference; find the area of a square described about it.
10. Two wheels of a carriage are 3 ft. 9 in. and 4 ft. 3 in., respectively, in diameter. How far will the carriage have gone when one wheel has gained 12 revolutions on the other?
11. Find the diameter of a circle whose area is equal to the sum of the areas of two circles, whose diameters are 12 in. and 16 in., respectively.
12. The diameter of a circular plate of lead is 16 inches. From this is cut out a circular piece of radius 4 inches, and the remainder of the lead is casted into the form of a circular plate with one-fourth of the former thickness. Find the diameter of this plate.
13. Two equal circles of radius of 2 ft. each touch one another externally; find the area of the space enclosed by the arcs between the touching point.
14. A circular ditch is surrounded by a road of width 10 ft. Find the inner side of the road, given that the outer circumference is 100 ft. in circumference, and the area of the road is 1000 sq. ft. How far would the road cover?

16. Find the cost of making a circular path 4 ft. wide, if the area inside is 100 sq. ft. and the cost is \$1.50 per sq. yd.

17. Find the area of a circular surface contained between two circles whose diameters are respectively 120 in. and 100 in.

XII.—THE CYLINDER

Form.—Surface = perim. of base $\times$ h. + twice area of base. **Volume** = area of base $\times$ h.

A.

Find the area of the curved surface of a cylinder

1. Height 8 in., circum. of base 12 ft.
2. Height 2 ft. 6 in., circum. of base 6 ft.
3. Height 1 ft. 10 in., circum. of base 4 ft. 5 in.
4. Height 30 ft., radius of base 3 in., $r = 3.1416$.

Find the area of the whole surface

5. Height 4 ft., radius 2 ft.
6. Height 5 ft., radius 3 ft. 6 in.
7. Height 5 ft. 6 in., circumference 30 ft.

Find the volume

8. Radius 2 ft., height 7 feet.
9. Radius 10 in., height 4 ft. 3 in.
10. Diameter 12 ft. 3 in., height 70 in.
11. How many cub. ft. of earth must be dug out to make a well 30 feet deep and 3 ft. in diameter?
12. The diameter of a well is 3 ft. 6 in., and its depth 20 feet. What was the cost of excavating it at an average of \$2.75 per cub. yard?
13. What is the cost of polishing a cylindrical drum 3 ft. in diameter and 12 ft. long, at 15¢ a square foot?

B.

14. Find the volume of a cylindrical shell 2 ft. thick, 12 ft. in height, the radius of the outer cylinder being 20 ft.

2. How many gallons of water will a cylindrical tank 3 ft. in diameter and 4 ft. in height hold? (A gal. is a volume of 231 cu. in., and a gallon 128 fl. oz.)

3. Two water wheels are driven in a cylindrical log 20 ft. long and 3 ft. 4 in. in diameter.

4. Water is flowing at the rate of 10 miles per hour through a pipe 14 in. in diameter, into a rectangular reservoir 120 yds. by 80 yds. In what time will the water be raised one foot?

5. A cubic ft. of water weighs 62.425 lbs., and a gal. of water weighs 10 lbs. How many gal. will a cylinder 10 ft. in diameter and 4 ft. deep hold?

6. A storage cistern is to contain 60 bbls., and is to be 6 ft. deep. Find the diameter of the excavation, allowing for a brick lining 5 in. thick. (1 bbl. = 61½ gal.; 1 cu. ft. = 61½ quarts.)

7. Two vessels, one in the form of a cube, and the other in the form of a cylinder, together hold 714 gal. of water. The diameter of the cylinder is 10 in., and the depth of the side 20 in. If a gal. weighs 10 lbs., and is 8.33 cu. ft., find the dimensions of the cube.

8. Compute the cost, at \$35.16 per ton of 2,000 lbs., of the weight of iron piping 25 in. internal diameter and 10 ft. long, assuming the specific gravity of iron to be 7.2, and a cu. ft. of water to weigh 62½ lbs., and a gal. 10 lbs.

THE CONE, AND PYRAMID.

Surface = (per. of base $\times$ s.) + area of base
Volume = (area of base $\times$ h.)

Surface of a curved surface of a cone

Surface of a frustum of a cone

Volume of a frustum of a cone

ARITHMETIC

16. Slant height 24 in., radius of base 1 ft. 6 in.
17. Slant height 2 ft. 5 in., diameter of base 1 ft. 5 in.
Find the area of the whole surface
18. Slant height 4 ft., radius of base 24 in.
19. Slant height 5 ft. 3 in., diameter of base 6.4 ft.
20. Slant height 12 in., circumference of base 3 ft.
Find the volume of a cone
21. Height 4 ft., radius of base 2 ft.
22. Height 5 ft., radius of base 42 in.
23. Diameter of base 8.4 ft., height 5.3 ft.
24. Circumference of base 12 ft., height 5 ft.
Find the volume of the square pyramid
25. Base 3 ft. square, height 4 ft.
26. Base 7 ft. 6 in. square, height 8 ft.
27. Base 14 sq. ft. 36 sq. in., height 3 ft. 9 in.
Find the volume of the triangular pyramid
28. Sides of base 3, 4, 5 ft., height 7 ft.
29. Sides of base 7, 8, 21 ft., height 4 ft.
30. Sides of base 5, 6, 6 ft., height 5 ft.
31. Sides of base 12, 14, 15 ft., height 16 ft.

B.

1. Find the contents of a cone whose altitude is 27 ft., and radius of base 10 ft.
2. The diameter of the base of a cone is 20 in., and its height 20 in.; find its volume.
3. The base of a pyramid is a square, each side of which is 2 ft. 6 in., and its height is 3 ft. 9 in.; find its volume.
4. The height of a right circular cone, whose slant height is 42 feet, is 40 feet; find the volume.
5. How many yards of canvas 35 in. wide will be wanted to make a conical tent 15 ft. wide and 10 ft. high, the diameter being cut away or turned in, as the maker likes?

EXERCISES

4. Find the volume of a cone the radius of whose base is 12 ft., and whose slant height is 13 ft. 5 in.
5. Find the volume of a cone whose diameter is 2 ft. 12 in., and slant height 3 ft. 5 in.
6. The base of a pyramid is a square whose sides are equilateral triangles; the side of the base being 20 ft., find the volume.
7. The base of a pyramid is a rectangle which is 24 ft. by 20 ft.; find the volume, each of the edges which meet at the vertex being 30 ft.
8. The base of a pyramid is a square, each side of which is 24 ft.; the length of the straight line drawn from the vertex to the middle point of any side of the base is 12 ft. Find the volume.

XLIII.—THE SPHERE.

Form.—Surface = $4\pi r^2$; volume = $\frac{4}{3}\pi r^3$.

A.

In the following $r = 3\frac{1}{2}$.

Find the surface area of a sphere

1. Radius $2\frac{1}{2}$ ft.
2. Radius 10 ft.
3. Diameter 8 ft. 2 in.
4. Circumference 12 feet.

Find the volume of a sphere

5. Radius 4 inches
6. Radius 5 inches
7. Radius 7 in., with surface 616 sq. in.
8. Diameter 12 inches
9. Diameter 21.2 feet
10. Circumference 3 ft. 2 in.

B.

Find the following without work.

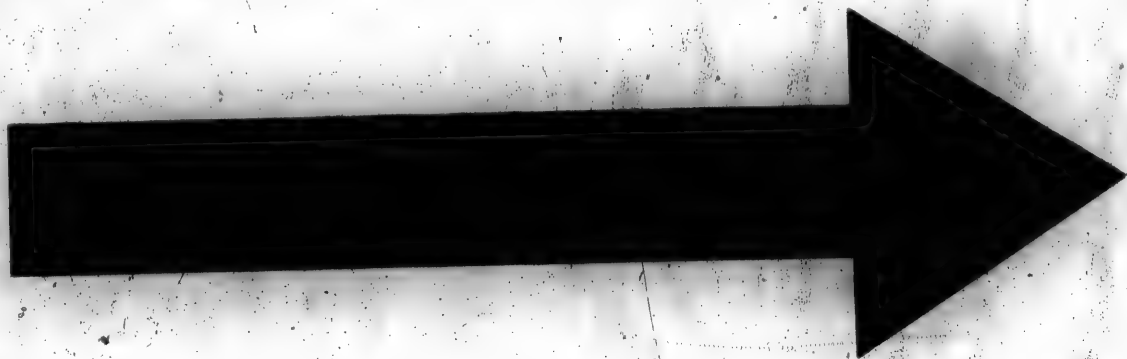
1. How much copper wire will be required to fill a hollow

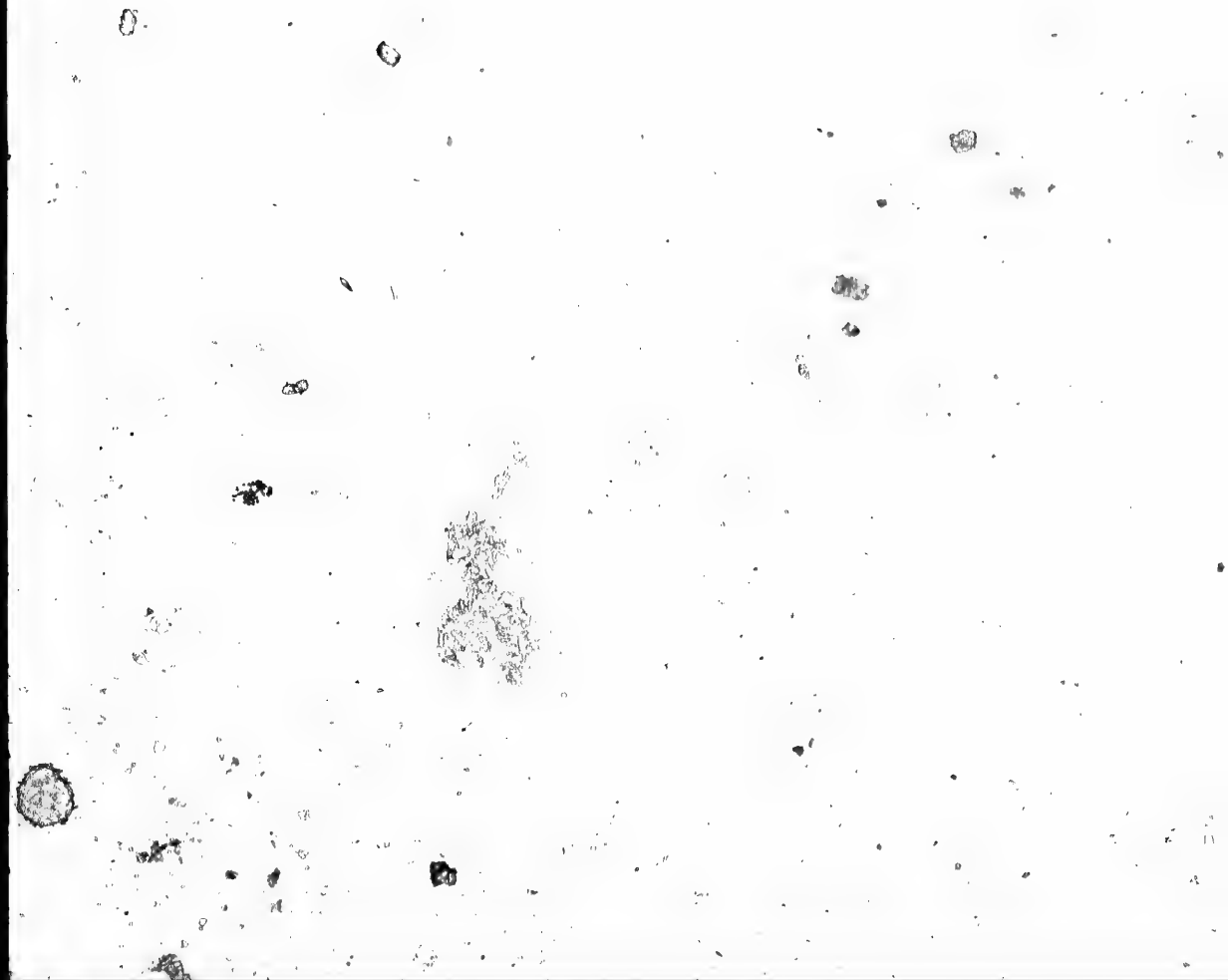
9. A sphere of 2 inches diameter, if 20 c. in. of water be poured into it, will be just covered.
10. Find the weight of a ball of gold 6 in. in diameter, if a cubic in. of gold weighs 19.35 grains.
11. The surface of a sphere is equal to half that of a similar cone; the radius of the base of the cone is 1 foot, and its height $\sqrt{5}$ feet. Find the volume of the sphere.
12. A spherical shell is 9 in. in diameter and its thickness is 1 inch; find the volume of the shell.
13. The inner radius of a spherical shell is 9 in., and the thickness of the shell is $\frac{1}{4}$ inch; find its volume.
14. Find the weight of a shell $3\frac{1}{2}$ in. thick whose external diameter is $17\frac{1}{2}$ in., if a cubic foot of the metal weighs 480 lbs.
15. A spherical shell, internal diameter 14 inches, is filled with water. Its contents are poured into a cylindrical vessel whose internal radius is 14 in.; find the depth of the water in the cylinder.
16. The diameter of the base of a cone is 4 in., and its volume is equal to that of a spherical shell of uniform thickness, the external diameter of which is 6 in. Find the height of the cone.
17. If a sphere, whose diameter is 4 feet, is submerged in the water of a circular cistern of 3 feet diameter, the water being 9 feet in depth, how high will be the water in the cistern?
18. Find how long it will take to fill a hemispherical tank of 16 feet in diameter, from a constant supply by a pipe 6.2832 gal. of water per second (1 c. ft. = $\frac{1}{6}$ gal.).

XIV. GENERAL PROBLEMS.

1. A number of men and women agreed to do a piece of work getting 24.75 each week, provided that there were 4 more men and 2 more women than

2. A rectangular prism is 12 in. high by 5 in. the base of the prism is 10 in. long by 3 in. and by 2 in. the area of the base is 6 sq. in. by 3 in.
3. A compound of tin and lead weighs 12 lb. and is as heavy as equal bulk of water, while tin weighs 7 times as much, and lead 11.25 times, as much as equal bulk of water. Find the number of pounds of each metal in 765 lbs. of the compound.
4. A house that cost \$15,500 rents for \$155 a month. It is insured at \$10,500 at 4% yearly; the taxes are 1% monthly on an assessment of \$12,450, and \$248.45 is spent each year on repairs. What rate of interest does the investment pay?
5. A regiment of a thousand men, four abreast, and marching 3 ft. apart, passes over a bridge 2 mi. 44 yds. long in 54 min. 30 sec. If each man takes 90 steps per min., determine the length of each step.
6. Explain how to find the vulgar fraction which equals $\frac{1}{2}$.
7. A person walks from P to Q at the rate of 4 mi. an hr., and one hour afterwards B starts from P and catches A in 4 hrs. Walking on, B arrives at Q 2 hrs. before A. Find the distance from P to Q.
8. A number of 3 digits is multiplied by 8, and the product placed to the left of the original number; show that the number so formed is always exactly divided by 7.
9. A bushel of water weighs 1,000 ounces; how many bushels will fall on 24 acres during a rainfall of $\frac{1}{2}$ inch?
10. A and B bottles and B 2 bottles of wine. An old friend C joins them, and the three share equally. To repay A and B, C hands over 100 dollars and B adds between 10 and 20 dollars.





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- the whole at 15c per quart?
16. A farmer sold two loads of wheat, in all 110 bu., for \$94.65. One load was sold at 97c. per bu., and the other at 72c. per bu. How many bushels were there in each load?
 17. If silver is worth \$1.10 per ounce, and gold \$17 per ounce, find the weight of a \$10 coin containing 57 parts in 49 of gold, and the rest silver.
 18. Equal volumes of iron and copper are found to weigh 77 oz. and 89 oz. respectively. Find the weight of $10\frac{1}{2}$ ft. of circular copper rod, when 9 in. of iron rod of equal diameter weigh $31\frac{1}{2}$ ounces.
 19. Find when first after 2 o'clock the hour and minute hands of a clock make an angle of 60° with each other.
 20. One kind of brick is $4\frac{1}{2}$ in. long and $\frac{1}{2}$ in. thick; another kind is 5 in. long and $3\frac{1}{2}$ in. thick. What is the size of the least piece of wall (height being the

26. A man rows 3 miles down stream in 40 minutes; without the aid of the stream it would take him an hour; how long will it take him to return against the stream?
27. A certain kind of brass is made by fusing together old brass, refined copper and zinc, in the proportion of 23, 55 and 24; how much refined copper must be taken to produce 170 lbs. of the brass, after allowing 24% for waste?
28. At an election in a constituency in which the number of votes was 1800, the votes polled by the candidates were in the ratio of 7 to 5, and the successful candidate was elected by a majority of 240. Find the number who did not vote.
29. Water is composed of two gases, oxygen and hydrogen, in the proportion of 80.9 to 11.1; what weight is there of each in a cub. yard of water (a cub. ft. of water weighs 1000 ounces)?

bbl.; on a credit of 8 moa. He sold it at \$3.50 per bbl. on a credit of 4 moa. Find his cash gain, money being worth 12%.

36. Sold 20,900 ft. of lumber for \$331.62 $\frac{1}{2}$ gaining thereby \$78.37 $\frac{1}{2}$. What had it cost per C.?

37. A runs a mile race with B and loses; had his speed been a third greater he would have won by 22 yards. Find the ratio of A's speed to B's.

38. How far may a rower go up a stream, the rate of which is 4 miles an hour, so that the round trip may take only 8 hours, if his speed is 6 miles an hour in still water?

39. Bought a lot of sheep at \$4 each, as many and 30 more at \$6 each; sold the whole lot at \$5.50 each and gains \$85. Find the number bought.

40. If my goods had cost 20% more my rate of gain would have been 25% less. Find my gain %.

47. Find the equated time : one half of a debt is due in 4 months, $\frac{1}{3}$ of it in 5 mos., and the balance in 6 mos.
48. One-sixth of a debt was due 16 days ago; one-half is due now; and the balance in 17 days. Find the equated time of payment.
49. A workman was hired for 45 days at \$1.80 a day for every day he worked, but with this condition, that for every day he was idle he was to forfeit 37 cents. On the whole he made \$84.44; how many days did he work?
50. Divide \$980 among 4 men, 16 women and 20 children, on the supposition that 1 man does as much as 3 women or 5 children.
51. A farmer employs a number of men and 8 boys; he pays the men \$1.10 a day and the boys 65c. The amount that he paid to all was as much as if each hand received 92c. per day; how many men were employed?

its selling price, what is the gain %?

80. A broker invests \$6,136 in stock at 35 $\frac{1}{2}$ and charges $\frac{1}{2}$ %; find his brokerage.
81. A merchant sells two kinds of flour, the superior at \$4.50 per bbl., and the other at \$5 per bbl. He sold 140 bbls. in all and realized \$740; how many of each kind did he sell?
82. A note for \$75 was given March 1, 1896, to be paid in 8 mos., with interest at 6% per annum till then, and then at 8% per annum till paid. The note was settled in full on June 28, 1897; find the amount.
83. Three persons, A, B and C, trade together, having a joint capital of \$4,708. A's money is in the bank for 8 mos., B's 6 mos., and C's 10 mos. Each took \$1,000 as his share of the profit. How much money did each contribute?

67. An officer can form the men of his regiment into a hollow square 12 deep. The number in the regiment is 1,296; how many men are in the front of the square?
68. If a snail crawl up a pole 81 inches during 12 hrs. of the night, and slip down 16 inches during 12 hours of the day, how long will it take the snail to get to the top of a pole 36 feet high?
69. A merchant in buying certain goods uses a pound weight $\frac{1}{2}$ oz. too heavy, and in selling them a pound weight $\frac{1}{2}$ oz. too light, and gains \$19 by his dishonesty. Find what he paid for the goods.
70. A boy starts from home, and walks to school at the rate of 11 yds. in 9 sec., and is 1 min. late. If he had walked at the rate of 22 yds. in 15 sec., he would have been half a minute early. Find the distance to the school.
71. A man in harrowing a field walks 25 miles in a day.

76. A has $\frac{1}{2}$ as much money as B, and B has $\frac{1}{3}$ as much as C; C gives A \$36, and still has twice as much as A. How much money has A?

77. A grocer sells 43 lbs. of tea and sugar for \$12.00. He sells the tea at 65c. per lb., and the sugar at 7c. per lb. Find how much he sold of each.

78. Find the number of cubic yards removed in excavating a tunnel half-a-mile long in the form of a half circle, the diameter being 20 feet.

79. A manufacturer sells goods to a merchant at a profit of $69\frac{1}{2}\%$; but the merchant fails and pays 62 $\frac{1}{2}$ c. on the dollar. What percent. will the manufacturer gain or lose?

80. A merchant sells goods for \$1,287. Half he sold at an advance of $33\frac{1}{3}\%$ on the cost; $\frac{1}{3}$ at an advance of 30%, and the remainder at 10% below cost. What did he pay for the goods?

81. An agent sold flour on a commission of 3%, and with the proceeds, minus his commission on both trans-

87. A's farm is $\frac{1}{2}$ mile square ; B's contains $\frac{1}{4}$ of a square mile ; C's is $\frac{1}{2}$ larger than A's and B's put together. How many acres are in C's farm ?
88. I mix 60 gal. Madeira wine, costing \$3.50 a gal., with 40 gal. of superior quality, and sell the mixture at \$4.44 per gal., thereby gaining 20%. Find the cost per gal. of the superior quality.
89. A circular garden 200 feet in diameter has a walk 6 feet wide around it on the outside, and another concentric walk of the same width whose outer circumference is 12 feet from the centre. Find the cost of gravelling these walks at 40c. per sq. yd.
90. The whole time occupied by a train 140 yds. long, travelling at the rate of 20 miles an hour, in crossing a bridge, is 18 seconds. Find the length of the bridge.
91. A and B begin business with \$1,000, and gained \$204, of which B received \$60 more than A. How much stock did each contribute ?

the quotient.

98. A circle whose radius is 10 in. has a square inscribed and a square circumscribed. Find the area of the spaces enclosed between the circumscribed square and the circumference of the circle; and, also the area of the spaces enclosed between the circumference of the circle and the inscribed square.
99. A man's income consists of a fixed salary of \$310 per annum, of dividends on shares paying 5% per annum, and of rents; if his dividends form $\frac{1}{5}$ of his total income and the rents $\frac{1}{3}$, find the amount of capital he has invested in shares.
100. The capital of a firm has been contributed by three partners as follows: A \$1,200, B \$1,600, C \$1,200, and it is agreed that the active partners, A and B, shall receive 20% and 12½% respectively of the profit for managing the business. The gross profit is \$1,500; find the share of each partner.
101. Find the cost of a draft in Montreal for \$1,000.

length, width and breadth each increased 10%.
What is the capacity after this is done?

194. A grain dealer sent his agent in Chicago 3,000 bus. wheat, which was sold at 80c. a bus. The agent deducted his commission, and also a 4% commission in advance on ton purchased for his employer. The two commissions amounted to \$200; find the rate of the first one.

197. A man invested 60% of his capital in 3½% stock at 90, and the remainder in 4% at 95, and his income was \$1,745 per year. What was the amount invested?

199. A dealer shipped 200 bbls. of apples to Liverpool, the cost being \$2.75 per bbl. For what sum must he have the apples insured at ½% prem. to guard against all loss in case of shipwreck, his other expenses being \$75?

200. A and B are partners, A's capital being $\frac{1}{3}$ of B's. At the end of five months A withdraws $\frac{1}{3}$ of his capital, and at the end of nine months B withdraws $\frac{1}{3}$ of his. How should they divide a gain of \$4,222.25 at the end of the year?

... of a 13-inch cannon-ball, the metal being 2 inches thick.

116. How much would it cost to kalsomine the walls and ceiling of a class-room at 6c. a sq. yd., the room being 30 ft. by 25 ft., and high enough to allow 150 cub. ft. of air to each of 50 pupils (no allowances for doors, windows or basing)?

117. Assuming that the 4-lb. loaf sells for 9c. when flour is \$8 a bbl., and the cost of making and delivering bread is one-half the cost of the flour, what should the 4-lb. loaf sell for if flour advances 30%, and the cost of making and delivering remain as before?

118. A merchant marks his goods at 30% advance on cost, but allows two successive discounts of 20% and 5%. What is his gain on sales which amount to \$2,300?

119. What is the quotation of exchange between Boston and London, England, when a bill of £340 costs \$3,107.88, the broker's commission being $\frac{1}{2}\%$?

120. Find the volume of the largest sphere that can be formed from a cube whose volume is 2,744 cub. feet.

number of acres in the field.

186. The sides of a triangle are 30, 40 and 50, respectively. Find the area of the triangle formed by joining the middle points of these sides.

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